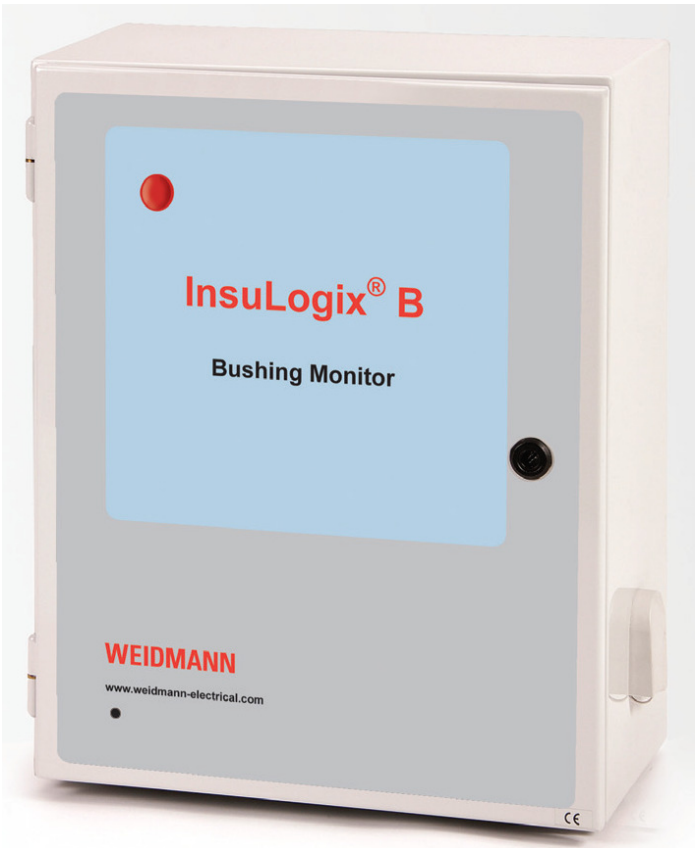
InsuLogix® B
Bushing Monitor
WEIDMANN
www.weidmann-electrical.com

WEIDMANN

INSULOGIX® B

User Manual - Revision 3.8

Power Factor/TanDelta Monitoring System
For Transformer Bushings, Current Transformer Bushings,
and Lightning Arrestor Leakage Current Monitor

High-Voltage Equipment - Read the entire manual before operating

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05/13

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Section 1 - INTRODUCTION

Receiving Instructions

It is very important that the equipment received is checked against the packing list to ensure that all materials are present. Notify WEIDMANN of any shortage at +1 802 748 8106 or e-mail to diagnostics.wds@wicor.com.

Please examine the equipment for damage received in transit. If any damage is discovered, file a claim with the carrier at once and notify WEIDMANN or nearest authorized sales representative, giving a detailed description of the damage.

The system has been thoroughly tested and inspected to meet rigid specifications before being shipped. It is ready for use when set up as indicated in this manual.

InsuLogix® B

⚠WARNING

BEFORE REPLACING FUSES, DISCONNECT THE POWER FROM THE INSULOGIX® B, AND GROUND THE INPUTS FROM THE MONITORED DEVICES

This continuous on-line monitoring system (hereafter referred to as the system or as InsuLogix® B) is a cost-effective, software-oriented, PC-based monitoring system running under Windows and using a standard SQL database for data storage. The system consists of specially designed hardware and software:

Hardware

- Bushing Tap Coupler (BTC)
- InsuLogix® B Cabinet (maximum of 32 AC or DC)
- Input Conditioning for up to 30 AC signals (3 per AC Input Board)
- DC Input Board for up to 8 DC level signals per board
- PC/104 Pentium MMX CPU Module
- 1GB DiskOnChip Memory Unit
- 500KHz PC/104 Analog-to-Digital Conversion Module
- Watchdog/Alarm Board (6 Alarm Outputs – 2 Digital/Analog Outputs)
- Optional Fiber Optic Network capability for 1300 nanometer multimode fiber optic cable with ST connectors

Software

- InsuLogix® B Software
- Symantec *PCAnywhere*
- Optional UCA 2.0 compatible device server

Introduction to InsuLogix® B

The InsuLogix® B is a continuous on-line monitoring system, for monitoring power factor in high voltage capacitive bushings, is now available with an optional leakage current monitor for high voltage lightning arresters. The system includes a minimum set of three sensors permanently connected to a series of capacitive bushing taps, or lightning arresters. It is based on the field proven SOS TanDelta System. The system is capable of monitoring up to 32 direct connected sensors, and up to 256 wireless sensors.

The system acquires, analyzes, and trends data pertaining to AC Insulation Power Factor of Bushings and/or HV Current Transformers, and leakage current of lightning arresters. The InsuLogix® B system can also interface to signals from other devices, or IEDs, such as: temperature sensors, DGA, or any 0-10Vdc, 10V peak, 4-20mA, or 0-1mA signal. Providing single point access of transformer mounted sensors.

Data can be downloaded on-site, or remotely. The system can also interface to an existing EMS system via a LAN/WAN, or dial-up connection to an IEC 61850 (UCA2.0™) network

PF and Insulation Stability

The deterioration of oilpaper insulation in high-voltage (HV) equipment is a matter of continuous concern. Normal aging of HV equipment is a slow process that takes place over 30 to 40 years due to thermal, electrical and environmental effects. Premature failure on the other hand is often a relatively sudden process that is not detected by periodic off-line tests. This prompted the need for continuous on-line insulation condition monitoring to manage the risk factor and to initiate maintenance procedures based on the condition of the insulation.

The power factor (PF) calculation in the InsuLogix® B system is based on the conventional Schering Bridge used in laboratories. Data is acquired under software control from transducers connected to the test objects associated with a transformer and then the data is compared to data from another electrical phase to produce a power factor value.

The eventual breakdown of insulation is a rapid avalanche of failing dielectric layers. Damaged or deteriorated dielectric is associated with:

- Increased dielectric losses (I^2R) with other sources of heating may eventually fuel a mechanism of thermal runaway. PF is a measure of dielectric losses.
- Partial discharges and treeing. High levels of partial discharge are reflected in the PF and are usually only present just after lightning or switching impulses and just before and during insulation failure.
- Increased sensitivity to changes in temperature, humidity, and moisture (i.e., increased temperature coefficient). Sources of heating include dielectric losses, ambient temperature, and more significantly, load fluctuations.

The concept of measuring PF is based on the derivation of the phase shift between two voltage signals. The method is similar to the standard bridge methods, but software is used for angle difference determination. The measurement of PF of insulation is accepted as part of well-established laboratory testing procedures to determine the quality of insulation at the factory before commissioning new and refurbished HV equipment. PF as a parameter is by nature a relatively slow-changing value and is an integral characteristic depending on:

- Design, materials and production technology
- Operating voltages and temperatures
- Aging of insulation related to design and operating conditions such as over-voltages, loading conditions, etc.
- Climatic/Weather related Phenomenon

The system calculates the PF of a unit as a relative value compared with a reference voltage from another unit in service, thereby eliminating the need for a standard capacitor. The reference device does not have to be associated with the same phase since InsuLogix® B will automatically make the proper phase angle adjustments. Relative measurements and evaluation can reduce the effect of influences such as ambient temperature, operating voltages, loading conditions, different aging characteristics, different designs, operating conditions, etc.

The system uses a principle of cross-referencing units in a closed loop to confirm all measurements and increase the confidence of isolating a defective unit. Because the system uses relative measurements, the minimum number of units to be monitored is three.

Continuous Monitoring of PF and other devices

The dictionary defines "continuous" as "without interruption." However, in the context of continuous on-line monitoring, the selected time between measurements must be sufficiently short so that the process can be considered, for all practical purposes, continuous.

All measurements are tested for integrity against three parameters: ***rms*** and ***mean*** of the signal, and the PF value calculated. Only measurements passing the integrity tests are stored in the database. The default monitoring period is once every 5 minutes. This setting can be changed from once a minute, to once per day.

The sensors are configured into the graphical user interface by the user during installation. Each monitored device is entered into the database with an acquisition channel number, and descriptive text. The condition of each monitored device is displayed on the monitor screen. See section 4 of this manual detail of software setup and operation.

Section 2 - SAFETY

The system and the specimen to which it is connected are a possible source of HV electrical energy and all persons making or assisting in tests must use all practical safety precautions to prevent contact with energized parts of the test equipment and related circuits. Persons actually engaged in the test must stand clear of all parts of the complete high-voltage circuit, including all connections, unless the test set is de-energized and all parts of the test circuit are grounded. Persons not directly involved with the work must be kept away from test activities by suitable barriers, barricades, or warnings.

Treat all terminals of HV power equipment as a potential electric shock hazard. There is always the possibility of voltages being induced at these terminals because of proximity to energized HV lines or equipment. Always disconnect test leads from power equipment before attempting to disconnect them at the system. The ground connection must be the first made and the last removed.

This equipment operates from a single-phase power source and requires a two-pole, three-terminal, line, neutral, and earth type source. The voltage to ground from the line pole of the power source must not exceed the maximum rated operating voltage. The neutral pole must be at ground potential. Before making connection to the power source, determine that the instrument rating matches the voltage of the power source.

Safety is the responsibility of the user. Follow your company safety procedures at all times.

Misuse of this HV equipment can be extremely dangerous.

The purpose of this equipment is limited to use as described in this manual. Do not use the equipment or its accessories with and device other than specifically described.

Never connect the system to energized equipment.

Do not use the system in an explosive atmosphere.

Qualified personnel who are familiar with the construction and operation of the system and the hazards involved must only perform corrective maintenance.

Refer to IEEE 510 - 1983, "IEEE Recommended Practices for Safety in High-Voltage and High-Power Testing," for additional information.

If the test equipment is operated properly and all grounds correctly made, test personnel need not wear rubber gloves. As a routine safety procedure, however, some users require that rubber gloves be worn, not only when making connections to the HV terminals, but also when manipulating the controls. WEIDMANN considers this an excellent safety practice.

Users of equipment should note that HV discharges and other sources of strong electric or magnetic field might interfere with the proper functioning of heart pacemakers. Persons with heart pacemakers should obtain expert advice on the possible risks before operating this equipment or being close to the equipment during operation.

Warning and caution notices are used throughout this manual where applicable and should be strictly observed. These notices appear in the format shown below and are defined as follows:

⚠ WARNING

WARNING, AS USED IN THIS MANUAL, IS DEFINED AS A CONDITION OR PRACTICE THAT COULD RESULT IN PERSONAL INJURY OR LOSS OF LIFE.

⚠ CAUTION

CAUTION, AS USED IN THIS MANUAL, IS DEFINED AS A CONDITION OR PRACTICE THAT COULD RESULT IN DAMAGE TO OR DESTRUCTION OF THE EQUIPMENT OR APPARATUS UNDER TEST.

Section 3 - InsuLogix® B HARDWARE INSTALLATION

Specifications

InsuLogix® B Cabinet

The InsuLogix® B Cabinet shown in the following figure contains all the equipment required to condition the input signal for acquisition and to provide electrical protection and isolation. The capacitance rating of the AC Input Boards in the InsuLogix® B Cabinet must be chosen so that they are tuned to the capacitance of the bushings or CTs being monitored. These signals are then routed to an Analog to Digital Converter and the resultant Power Factor variables are stored in an on-board long term memory device for periodic statistical analysis to determine if an insulation deterioration condition exists.

InsuLogix® B Cabinet

Signal inputs:	
Number of AC analog input channels	30 AC Max (3 per AC Input Board)
Input impedance	50 Ω (< 1 kHz)
Signal input mode	Differential
Maximum full scale voltage	60 V rms
Operating voltage	29 V rms
Isolation between inputs	3000 V
Surge withstand capabilities	ANSI/IEE C37.90.1-1989 IEC 254
Number of DC analog input channels	32 DC Max (requires an 8 channel DC Input Board)

Signal outputs:	
Isolated Alarm Contact Outputs	6 Contacts, Max DC 200V, Max Current DC 1 A.
Digital to Analog Output Channels	2 (12 Bit Channels), +/- 5, 0 to 5, or 0 to 10 Volts Analog Output range.

• Dimensions	20 in. Tall x 16 in. Wide x 8 in. Deep (49cm x 40.64cm x 20.32 cm)
	Weight: 45 lbs (20.4Kg)
• Environmental	BTC and Interface Cabinet : -40°C to +65°C, 0 to 95% humidity
	non-condensing
	Pollution Degree 1
• Power Supply	Isolated supply to cabinet 110/220 V AC, 50/60Hz, 40W

Bushing Tap Coupler (BTC)

A BTC is used in conjunction with a capacitive divider circuit in the InsuLogix® B Cabinet to produce a measurable signal from the test object (CT or bushing). BTCs are essentially capacitive transducers with protection and signal conditioning limiting continuous voltage to 29 V RMS. Each BTC and InsuLogix® B Cabinet are configured and supplied with a specific designation to a test object in the substation so that it is tuned to the capacitance of the bushing or CT. The BTC circuit is contained in a watertight container, complying with NEMA type-4 protection classification.

Dimensions and Weight:

BTC - Varies depending on the bushing type and manufacturer.

The BTC mounting varies depending on the type of CT or bushing to be monitored. Refer to Pre-Installation Instructions and Installing the BTC for mounting instructions.

Typical BTCs

BTC/MTU Cable

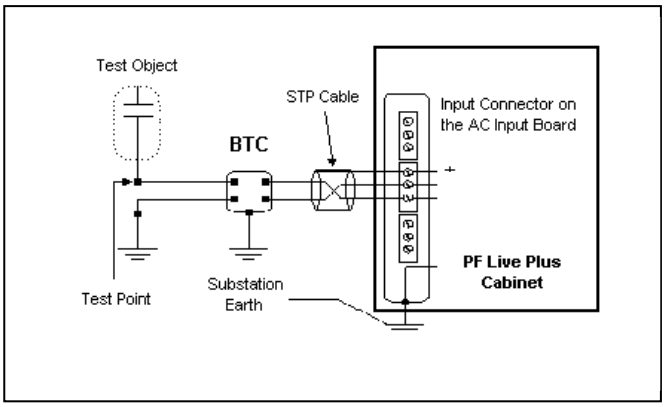
Single Twisted Pair (STP) signal cable is used for all signal transmission from the BTC to the InsuLogix® B Interface Cabinet. A fifty foot (50) cable is provided for each BTC/MTU.

However, the cable may be up to a maximum of 1000 feet in length. The cable specifications are:

- Single STP: rated for 2 kV AC insulation levels (Belden 9342).
- Minimum shield/drain gauge > 0.7 mm^2
- Minimum core gauge > 0.7 mm^2
- Individual and overall STP bundles with several individually shielded pairs in each.
- Overall shielding with drain wire.
- Minimum drain wire gauge > 1.0 mm^2

Pre-Installation Instructions

Before starting the installation, it is important to understand the overall system layout and cable and shield connections. Read and understand Section 2, Safety, before installing the system. The following figure shows the signal cable and shield connections from the test object to the BTC and terminated at the InsuLogix® B Cabinet.



Signal Cable and Shield Connections

Preparations for Installation

Complete the Installation Checklist, provided in Appendix A. Preparations should include the following configuration documentation:

- Installation schedule
- Cable layout and length
- Channel allocation for hardware installation and software configuration

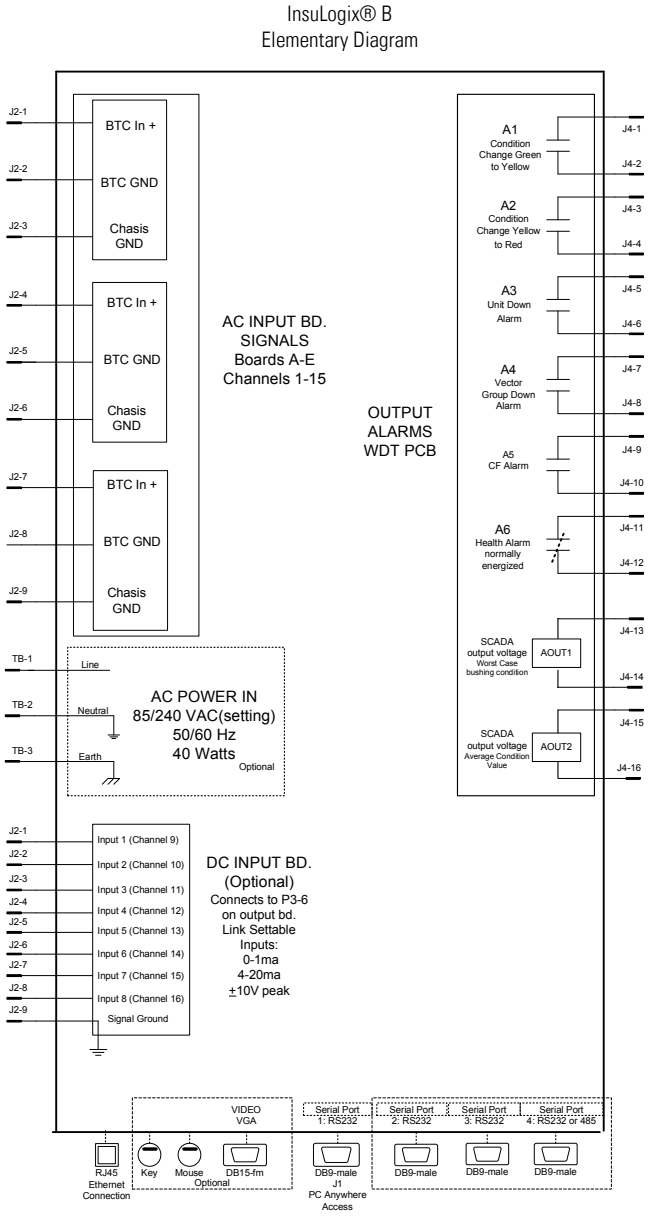
Establishing Test Points

The last foil of the capacitive graded HV equipment (bushings for Transformers and Current Transformers) is the test point (otherwise referred to as measurement or capacitive tap point). This is either brought out as a test point or it is connected internally to the base metal of the unit. The following scenarios exist for units with and without a capacitive test point:

For test objects with a capacitive test point: On a bushing, a test point may be available under a removable cap which otherwise grounds the test point. In this case a Bushing Tap Coupler is needed for the test point that houses the measuring circuitry as shown in the following figure.

Test Bushing with BTC connected

Some CT Bushings have a test point available in the secondary box, where a link connects it to the base of the unit. This link should be removed to provide a test point.



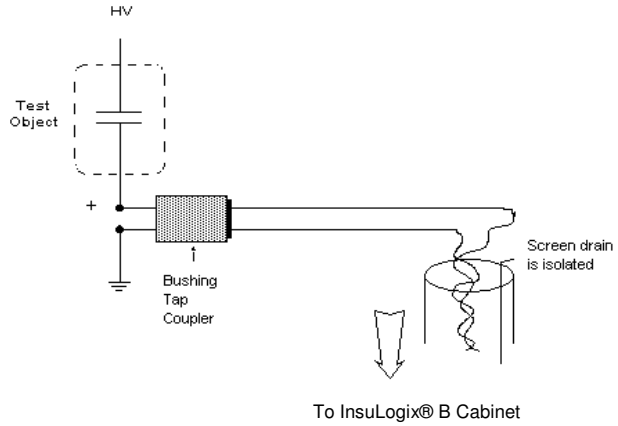
Elementary Diagram

Installing the BTC

⚠ WARNING

THERE IS ALWAYS THE POSSIBILITY OF VOLTAGES BEING INDUCED AT THE TERMINALS OF A TEST OBJECT BECAUSE OF PROXIMITY TO ENERGIZED HIGH-VOLTAGE LINES OR EQUIPMENT. A RESIDUAL STATIC VOLTAGE CHARGE MAY ALSO BE PRESENT AT THESE TERMINALS. GROUND EACH TERMINAL TO BE TESTED WITH A SAFETY GROUND STICK, THEN INSTALL SAFETY GROUND JUMPERS, BEFORE MAKING OR CHECKING CONNECTIONS.

The BTC is coupled mechanically and electrically to the tap-point of each test object via an appropriate adapter bolted or threaded onto the bushing. The BTC is placed physically close to the test point to secure a safe signal voltage through adequate voltage division and protection. See the following figure.



BTC Connection Diagram

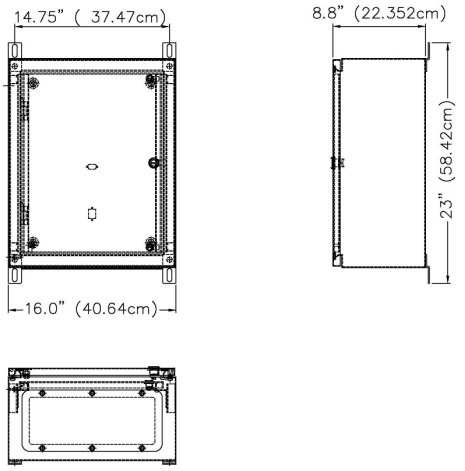
⚠ CAUTION

THE SCREEN DRAIN OF EACH TWISTED PAIR MUST NOT BE GROUNDED TO SUBSTATION EARTH AT THE BTC OR TEST OBJECT. THE ONLY POINT TO WHICH THE INDIVIDUAL STP SCREEN DRAIN IS CONNECTED TO EARTH IS VIA THE TERMINAL BLOCKS IN THE INSULOGIX® B CABINET

Installing the InsuLogix® B Cabinet

Since each combination of BTC and InsuLogix® B Cabinet is manufactured and supplied to correspond to a designated test object, be sure the correct cabinet is installed. The following figure provides the dimensions and location of the mounting holes for the InsuLogix® B Cabinet.

The Cabinet must be mounted low enough that test personnel can attach the Communications Cable from an external computer, yet close enough to the test object base or support frame to afford short connections to the BTCs assigned to this Cabinet. The InsuLogix® B Cabinet must be solidly connected to substation earth.



InsuLogix® B Cabinet Mounting Dimensions

InsuLogix® B Power and Input/Output Connections

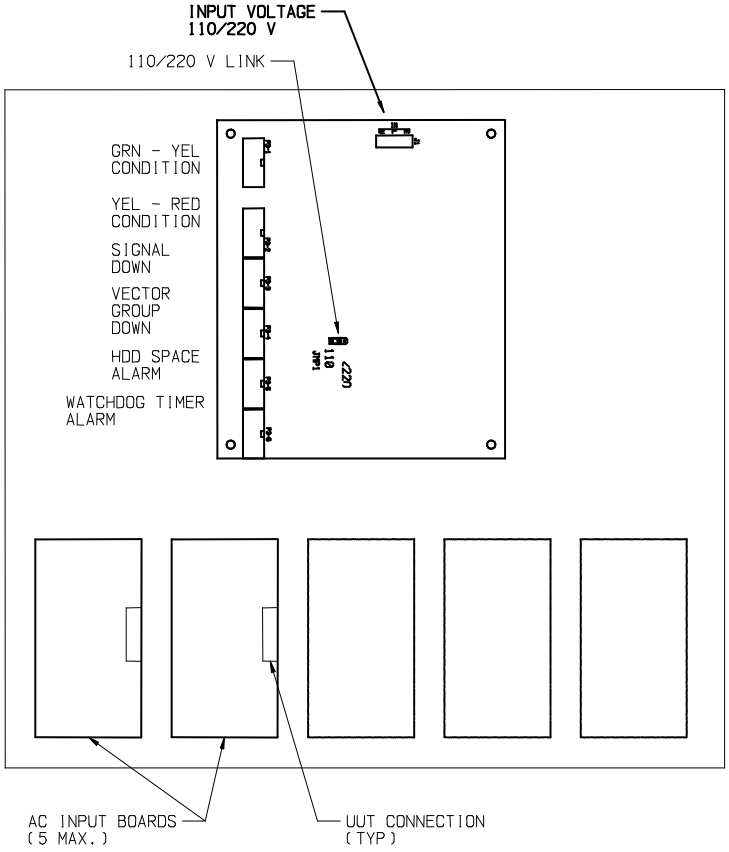
Power Source Connections

The isolated power source should enter the cabinet via a weatherproof hole in the bottom of the cabinet and connected to the J1 connector on the WDT/ALARM board as shown in the Power Connections and Jumper Setting figure. The board has an "IN" designation next to the J1 connector and "E" (Earth), 'L" (Line), and "N" (Neutral) designations on the board from right to left indicating where the power cable should be connected.

The jumper JMP1 in the lower middle of the WDT/ALARM board should be positioned to the left for a 110-volt power source and to the right for a 220-volt power source. There are "110" and "220" designators on the board next to the JMP1 jumper.

⚠ WARNING

THERE IS ALWAYS THE POSSIBILITY OF VOLTAGES BEING INDUCED AT THE TERMINALS OF A TEST SPECIMEN BECAUSE OF PROXIMITY TO ENERGIZED HIGH-VOLTAGE LINES OR EQUIPMENT. A RESIDUAL STATIC VOLTAGE CHARGE MAY ALSO BE PRESENT AT THESE TERMINALS. GROUND EACH TERMINAL TO BE TESTED WITH A SAFETY GROUND STICK, THEN INSTALL SAFETY GROUND JUMPERS, BEFORE MAKING OR CHECKING CONNECTIONS. ENSURE THAT THE OBJECT TO BE TESTED IS COMPLETELY DE-ENERGIZED AND DISCHARGED.



Power Connections and Jumper Setting

AC/DC Input Signal Connections

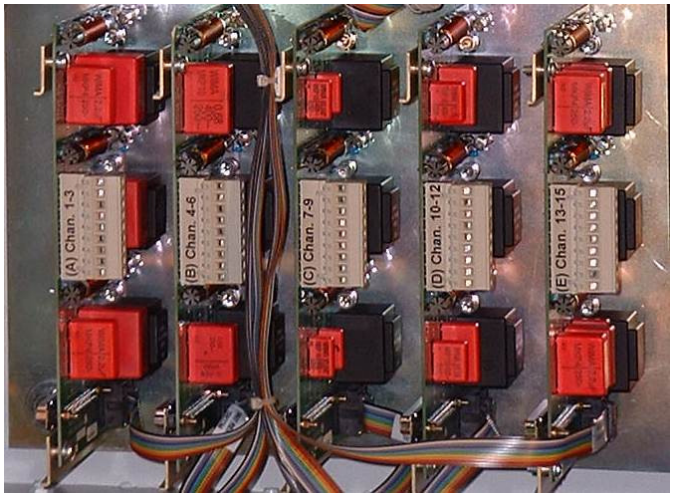
⚠ WARNING

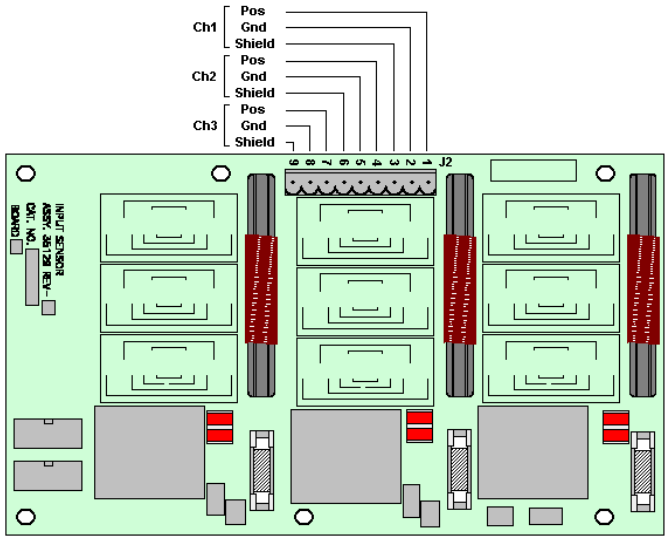
THERE IS ALWAYS THE POSSIBILITY OF VOLTAGES BEING INDUCED AT THE TERMINALS OF A TEST SPECIMEN BECAUSE OF PROXIMITY TO ENERGIZED HIGH-VOLTAGE LINES OR EQUIPMENT. A RESIDUAL STATIC VOLTAGE CHARGE MAY ALSO BE PRESENT AT THESE TERMINALS. GROUND EACH TERMINAL TO BE TESTED WITH A SAFETY GROUND STICK, AND THEN INSTALL SAFETY GROUND JUMPERS, BEFORE MAKING OR CHECKING CONNECTIONS. ENSURE THAT THE OBJECT TO BE TESTED IS COMPLETELY DE-ENERGIZED AND DISCHARGED.

The Installation Checklist (Appendix A) requires the capacitance values of each test object so the divider capacitance rating of the InsuLogix® B Cabinet can be selected before installation.

Together with the BTC, the capacitor divider circuit in the InsuLogix® B Cabinet transforms the voltage across the Test Tap to a voltage signal of approximately 29V rms. The STP cable from the BTC is connected to the input terminals in the InsuLogix® B Cabinet.

Each AC Input board in the InsuLogix® B cabinet can handle up to three AC input signals from the bushing tap couplers. The terminal block on the AC Input board has nine connection posts. Each STP from a BTC will use a set of three consecutive connections on the terminal block. The first input on this AC Input board will use the right set of three posts on the terminal block, the second input will use the middle set of three posts, and the third input will use the left set of three posts. The right most connector of each set of three connectors on the nine post terminal block is for the (+) positive signal, the middle connector is for the ground connection, and the left connector is for the shield connection in the STP. The following figure illustrates the terminal block on the AC Input board.





Typical AC Input Board Arrangement and Board Layout

The DC Input board uses the same type of terminal block with nine connector posts. The right most connection is for DC channel 1 and up to eight DC channels can be monitored. The ninth connection on the terminal block is for the ground input.

Digital Alarm Outputs

The digital alarm outputs are connected to the J4 terminal block on the WDT/ALARM board and are designated as "A1" thru "A6" on the board next to the J4 connector. It is highly recommended that at least three of these Digital Alarm outputs (A2, A3, and A6) be attached to external SCADA equipment so that the operational status of InsuLogix® B can be monitored at a remote location. The alarm conditions associated with these digital outputs are as follows:

- A1 Normally open and will close if the condition of a unit changes from green to yellow.
- A2 Normally open and will close if the condition of a unit changes from yellow to red.
- A3 Normally open and will close if the signal from a single unit is down.
- A4 Normally open and will close if the signals from a vector group (3 units) are down.
- A5 Normally open and will close if the available disk space on the computer is below the specified percentage.
- A6 Normally closed and will open if the Monitoring program stops (e.g. when the operating system crashes or the PC hangs).

Analog Alarm Outputs

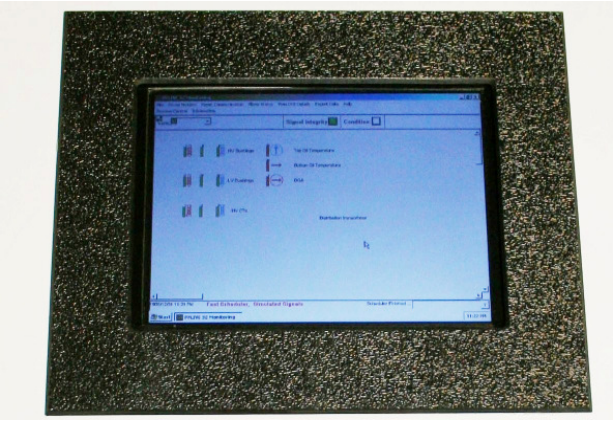
This feature of InsuLogix® B can be used to convert two internal variables, such as selected condition values and display them as a voltage in the 0 to 10 volt range. They are designated as "A/01" and "A/02" on the WDT/ALARM board next to the J4 connector. The high side of the device receiving the output should be connected to one of these two posts and connect the low side of the device should be connected to the associated "GND" post.

A/01 represents the worst case bushing condition value from 0 to 100%. The output voltage ranges from 0 to 10V DC the voltage level is a representation of the condition value of the bushing. For example, if the bushing condition value is 50%, then the voltage will be 5V DC.

A/02 is an analog 0 to 10V DC voltage. The voltage level is a representation of the average condition value all of the bushings monitored. For example, if the average bushing condition value is 50%, then the voltage will be 5V DC.

Touch Panel Display

Some models of the InsuLogix® B have an optional LCD Touch Panel display mounted on the inner door. This allows the user to view the monitor screen and access the control program via the touch panel display. The display can be operated with a finger or stylus to access the control and graphs applications as well as the monitor screen.



InsuLogix® B with Optional Display

Some models of the InsuLogix® B Cabinet have a RED/YELLOW/GREEN condition value status LED mounted on the outer door of the enclosure. This LED indicates the status of the worst case bushing and matches color of the status LED as shown on the monitor Screen and detailed in section Main System Display.

Green will indicate that all units are in a green condition, yellow will indicate that at least one unit has a yellow (warning) condition, while red will indicate that at least one unit has a red (alarm) condition. Off indicates that the analysis function has not been able to determine a condition value during system startup or that reference window data is being collected.

Current Sensor Connection

The Leakage Current monitoring option for Lightning Arresters consists of a minimum of three sensors, one for each phase. Each of these sensors has a bandwidth 50 Hz to 10 kHz. Its measuring capability is from 0.5 mA to 300 mA with accuracy in the µA range. The amplitude error is less than 1% and the phase shift is less than 1 degree. The sensor is well protected to survive lightning and switching surges.

It is required that the Lightning Arrester be insulated at its base and has a single ground point.

Lightning Arrester monitoring is achieved by connecting a Current Transformer across the Ground Strap of the Lightning Arrester to measure the total leakage current. This total leakage current is made up of 2 main components:

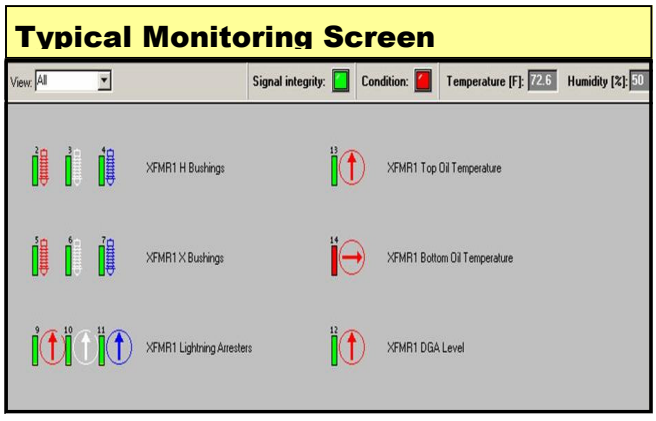
1. Surface Leakage Current caused by pollutants being deposited on the ceramic surface.
2. Resistive Leakage Current traveling through the metal oxide blocks due to the changes in the characteristics of the arrester material, requiring replacement of the Arresters.

Typical Lightning Arrester Connection.

Note: *The Arrester base must be isolated from Ground.*

Increased levels of leakage current can be due to changes in either of the above two cases, and it would require corrective action. If a wash down of the surface pollutants of the ceramic does not decrease the leakage current, then the metal oxide blocks are changing their characteristics. Further off-line tests on the Lightning Arrester will confirm that they are not fully protecting the transformer, and that they should be replaced.

The InsuLogix® B software is a field proven and versatile software that will accommodate the inputs from various IEDs. In the case of leakage current from Lightning Arresters, the data is obtained at a user settable interval, analyzed and stored. A Graphical indication of the changes in leakage current is displayed on the Monitoring Screen of the InsuLogix® B. The value of the leakage current will start filling the green bar from the bottom with yellow (Warning). A full yellow bar will start changing with Red from the bottom, as the leakage current further increases (Alarm). (See Figure below).



Monitoring Screen - 3 Lightning Arresters being monitored.

A full yellow bar indicates a 70% change from the baseline leakage current value, and a full Red bar indicates a 100%

change from the baseline value. On reaching either stage, the Plus system will provide an "Alarm", or a "Warning", indicating a potentially sensitive situation which requires immediate attention.

As a level device an alarm point can also be set for an alarm when the leakage current exceeds a predetermined value.
.

The factory default setting is 5mA and is suitable for most lightning arrestors. However, the user should refer to the instruction manual of the lightning arrester or the manufacturer of the lightning arrester for the proper Alarm set point. This Alarm is reported on the monitoring screen and via SERIAL, DNP3, or IEC61850 communications.

SECTION 4 - InsuLogix® B CONFIGURATION AND OPERATION

InsuLogix® B software

Introduction

The InsuLogix® B software can be accessed from the InsuLogix® B program group (Start – Programs - InsuLogix® B x). The programs (x) in the InsuLogix® B suites are:

- Control - This program is used for all configuration and diagnostics of the InsuLogix® B system. Please note that Monitoring should be stopped before executing Control.
- Monitoring - This program performs the continuous monitoring and reporting of the insulation conditions and signal integrity in the substation.
- Graphs - This program gives the user the ability to investigate data captured over time by Monitoring.

Access Control

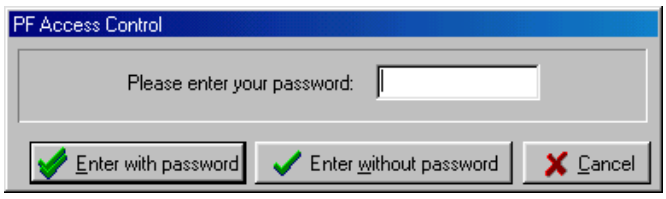
Access to the Control program is restricted. Without the password, a user will not be allowed to change any information regarding the units in the system or any system settings.

No password is needed to access the Monitoring program, as it must start up automatically with Windows without any user intervention or with the Graphs program as it is only used to view data.

NOTE: *The default password is "MASTER" and should be changed after installation using InsuLogix® B Control.*

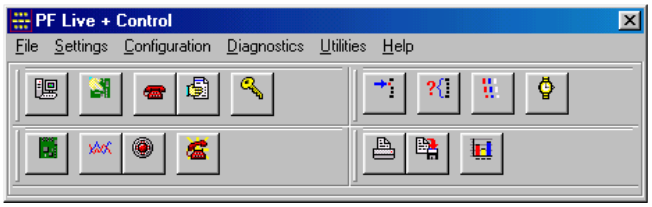
InsuLogix® B Control

The user can access InsuLogix® B Control in various modes using the InsuLogix® B Access Control screen displayed below.



InsuLogix® B Access Control

Accessing Control with a password will allow the user to make changes to the system configuration and settings and entering without a password will only allow the user to use the diagnostic tools.



InsuLogix® B Control

The functionality in Control is grouped into settings, monitoring configuration, diagnostic tools, and other utilities categories.

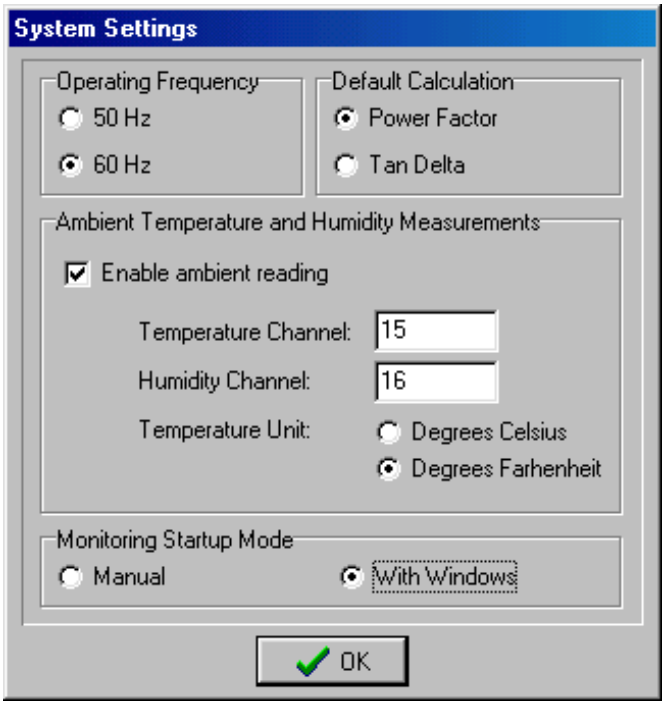
Settings

Various settings controlling the operation of InsuLogix® B can be specified using Control.

System Settings

Menu: *Settings - System*

System settings includes the system frequency at which the units will operate (50 or 60 Hz), selection of either the Power Factor or TanDelta calculation, the temperature units of measure, the input channels for the temperature and humidity DC level sensors, and Monitoring Startup Mode which should be set to "With Windows" in order to have Monitoring automatically startup on Windows startup.



InsuLogix® B System Settings

The difference in the result of the Power Factor calculation and the TanDelta calculation is insignificant when the angle between the two phases is small. The equations for these calculations are given for reference only and in this manual the Power Factor calculation is assumed.

TanDelta = ((a2*b1 – a1*b2)/(a1*a2 + b1*b2))

Power Factor = cos(pi/2 – arctan(TanDelta))

The final result is expressed as a percentage.

TanDelta = 100 * TanDelta or Power Factor = 100 * Power Factor

Acquisition Settings

Menu: *Settings – Acquisition*

These pre-configured settings are used for data acquisition through an A/D device and should not be changed.

Communication Settings

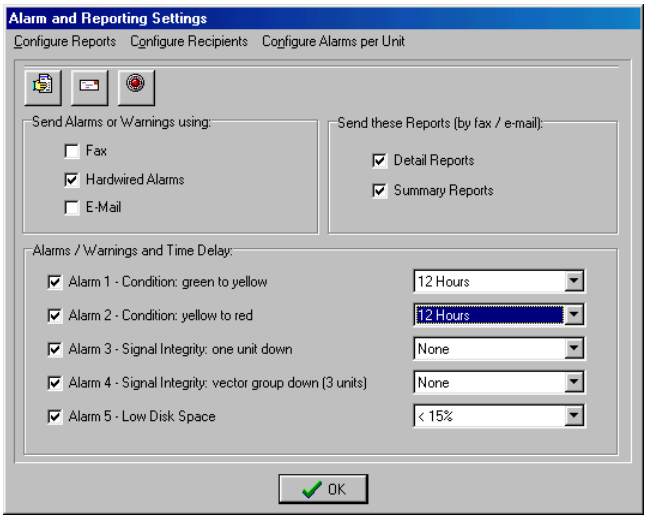
Menu: *Settings – Communication*

These communication settings are pre-configured based on the InsuLogix® B model ordered and should not be changed.

Alarm and Reporting

Menu: *Settings – Alarm and Reporting*

The Alarm and Reporting Settings allow the user to configure the various reports and automatic alarms available in InsuLogix® B.



InsuLogix® B Alarm and Reporting Settings

In the Send Alarms or Warning using section, only specify that InsuLogix® B should send alarms/warnings as hardwired alarms contacts unless the Modem or Network options are included.

In the Send These Reports section, specify the reports that you want InsuLogix® B to generate so they can be viewed using pcAnywhere.

In the Alarms/Warnings and Time Delay section, specify which alarms InsuLogix® B will report with the time delay that InsuLogix® B should wait before activating the specific alarm.

Types of Alarms and Time Delays

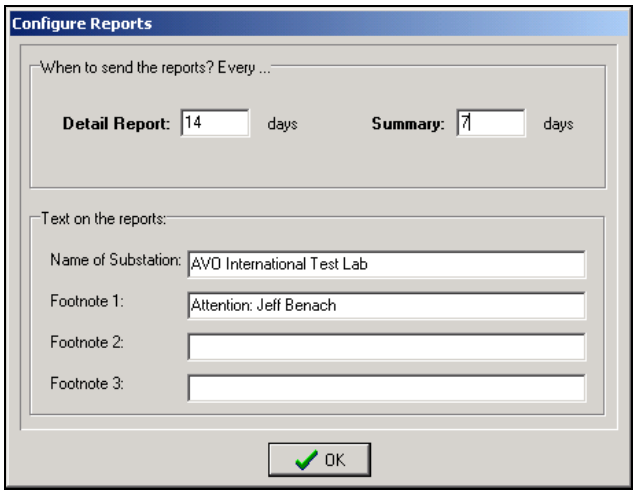
The following alarm types are available in InsuLogix® B:

Alarm 1	Condition	The condition of a unit went from green to yellow.
Alarm 2	Condition	The condition of a unit went from yellow to red.
Alarm 3	Signal Integrity	The signal from a single unit is down.
Alarm 4	Signal Integrity	Signal Integrity Alarm: The signals from a vector group (3 units) are down.
Alarm 5	System	The available disk space on the computer is below the specified percentage.

A time delay can be specified for alarms 1 through 4, before InsuLogix® B will actually activate the alarm. Waiting times of 0 (none), 1 hour, 12 hours, 1 day, or 1 week can be specified. If a time delay is specified and the problem (e.g. signal down – alarm 3) corrects itself in the waiting time, the alarm will not be activated.

Configure Reports

Menu: *Configure Reports*



Configure Reports

In the report configuration, reporting times (in days) can be specified for both the detailed and summary reports. *Text on the reports* section is used to specify a header for the reports (substation name or identifier), as well as up to 3 footnotes to be displayed on the reports. The footnotes could be used to specify a support contact person and telephone number.

Configure Recipients

This function is not utilized in InsuLogix® B since it will not normally be connected to a telephone line or network.

Configure Alarms per Unit

Menu: *Configure Alarms per Unit*

Alarms can be further configured per unit. By default, all alarms will be enabled for all units in the monitoring set, but the user can disable certain alarms for specific units (i.e. the alarm will not be activated for the unit).

Change Password

Menu: *Settings - Change Password*

Selecting the Change Password menu item allows the password to be changed. Enter the old password that needs to be changed and the new password and confirm the new password (the OK button will be disabled if the new password is not confirmed).

Configuration

When configuring the InsuLogix® B system for monitoring, the user specifies the units to be monitored, their layout on the screen (one-line diagram), the sequence in which they should be sampled, and how often the various units should be sampled (sampling schedule).

The user will need the following information before configuring InsuLogix® B for monitoring:

- A list of all units to be monitored.
- Information on every unit, such as type, manufacturer, serial number, voltage, feeder and phase.
- A physical layout of the units in the substation (one-line diagram).

Every unit in the system will be assigned a unique unit ID and a channel number (assignment corresponding to the physical hardware channel).

NOTE: *The assignment of channel numbers is made when wiring the BTC to the InsuLogix® B cabinet. To reduce the possible complexity of the configuration, unit 1 should be wired to channel 1, etc.*

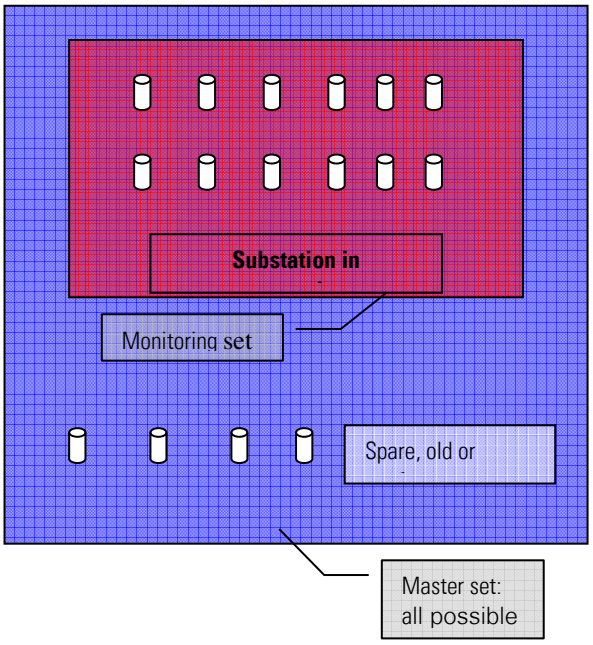
Background

The analysis that the software performs is partly based on correlation between comparative units. These comparative units are specified in the PF/TanDelta and Vector groups. Comparative units are:

- Equipment of similar type (i.e. comparison of CTs with CTs, and bushings with bushings)
- Equipment of similar manufacturer
- Equipment with similar load profiles (i.e. industrial and domestic)
- Equipment exposed to the same weather conditions (i.e. outside vs. inside, shade vs. direct sunlight, etc.)

The units to be monitored are grouped in a monitoring set. The monitoring set consists of information on all the units to be monitored by the InsuLogix® B system in a substation, as well as information about the way in which the monitoring must take place. Some units could be added and then temporarily taken out-of-service, which means that they will not be monitored while they are out-of-service. Only units in-service are monitored and thus included in the sampling sequences and screen layout.

NOTE: *Monitoring Set = All 'in service' Units = All Units to be Monitored.*



Monitoring Set

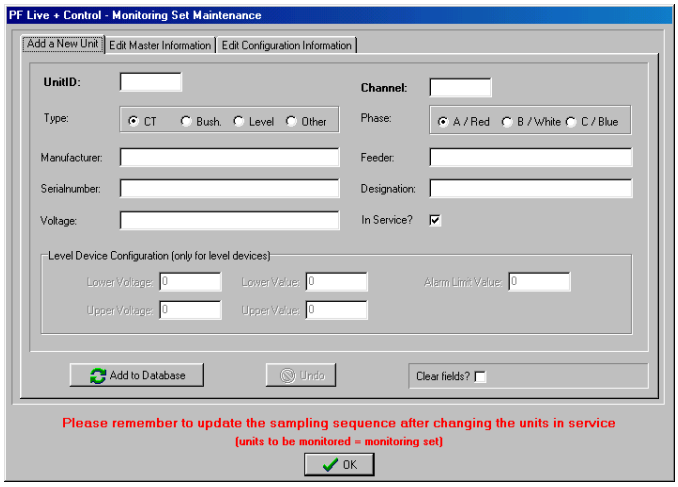
Monitoring Set

Menu: *Configuration – Monitoring Set*

The Monitoring Set Maintenance screen consists of three tabs:

- Add a New Unit into the system;
- Edit Master Information – physical information about the unit (e.g. a 25kV bushing);
- Edit Configuration Information – information about the utilization of the unit (e.g. Phase B feeder 5).

Add a New Unit



Enter the UnitID of the device to be monitored (we recommend that you begin with 1 and follow the sequence as connected in InsuLogix® B cabinet). Note that the channel number will by default be the same as the UnitID, the user needs to change this manually if this is not the case.

All *DC Level* type units should be entered after all the PF/TanDelta units (CT, Bushing, Other) have been added. When Level units are added, ensure that all the needed information in *Edit Configuration Information* is specified.

Enter all the relevant information for the unit. Note that *Voltage* refers to the voltage of the source to which the unit is connected, and that *In Service* indicates that the unit must be included in the monitoring set and thus monitored.

By clicking *Add to Database*, the unit is added to the system database. Repeat for every unit that needs to be added. The *Clear Fields* option resets all fields when clicking *Add to Database*, leaving this option unchecked will retain the previously enter information when adding a new unit (should be used when most of the information is the same).

Lightning Arrester Monitoring Setup

Lightning arresters are DC level type units, and are configured to measure leakage current. The lightning arrester settings are usually configured when the unit is shipped from the factory. If a leakage current sensor is added in the field select the add a unit tab as shown in InsuLogix® B "Alarm and Reporting Settings".

Follow the steps for adding a DC Level unit in section configuring a DC Level Type Device and enter all the relevant information for the unit. Note that *Voltage* refers to the voltage of the source to which the unit is connected, and that *In Service* indicates that the unit must be included in the monitoring set and thus monitored.

By clicking *Add to Database*, the unit is added to the system database. Repeat for every unit that needs to be added. The *Clear Fields* option resets all fields when clicking *Add to Database*, leaving this option unchecked will retain the previously enter information when adding a new unit (should be used when most of the information is the same).

Edit Master Information

On the *Edit Master Information* tab, the physical information of units in the system can be viewed or edited. This includes type, voltage, manufacturer and serial number.

NOTE: *A unit cannot be deleted out of the system – when a unit should not be monitored anymore, remove the check in the In Service option on the Edit Configuration Information tab.*

Edit Configuration Information

On the *Edit Configuration Information* tab, the utilization information of units in the system can be viewed or edited. This includes phase, channel assignment, feeder, some other designation for the unit, whether the unit must be monitored (In Service) and some level device specific information.

Configuring a DC Level Type Device

When a new *Level* type unit has been added, it is important the level specific settings in *Edit Configuration Information* also be specified. This includes:

- Lower Voltage - Enter the lowest operating voltage for the level device.
- If you are configuring a 4 to 20mA Current loop device, 4ma=1VDC, 20ma=5VDC for this setting. The 4-20mA link must be in place on the DC input board for this type of device.
- If you are configuring a 0 to 1mA Current loop device, 0mA=0VDC, 1mA=5VDC. The 0-1mA link must be in place on the DC input board for this type of device.
- Lower Value - Enter the number of counts the lowest voltage level represents.
- Higher Voltage - Enter the highest operating voltage for the level device.
- Higher Value - Enter the number of counts the highest voltage level represents.
- Alarm Limit - The alarm limit count value is used to determine the alarm state of level devices.
- After the voltage from the level device is converted to a count value, if it exceeds 90 percent of the alarm limit count value, the unit is considered to be in an alarm state and if the voltage count value exceeds 70 percent of the alarm limit count value, the unit is considered to be in a warning state.

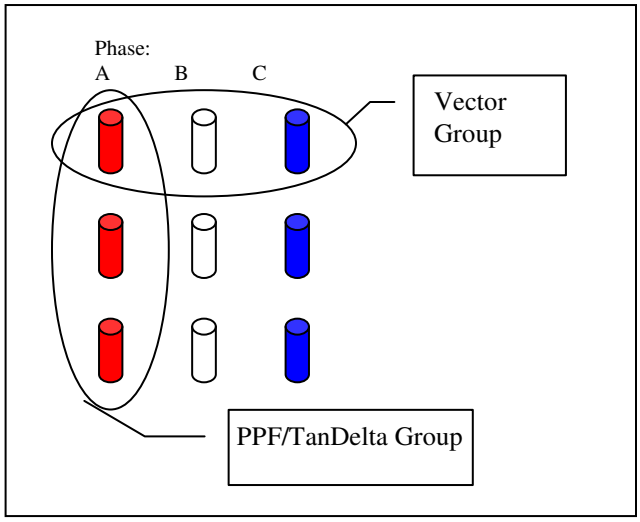
Sampling Sequence

Menu: *Configuration – Sampling Sequence*

The sampling of all units in the monitoring set will happen in three steps: PF/TanDelta sampling, Vector sampling, and Level sampling.

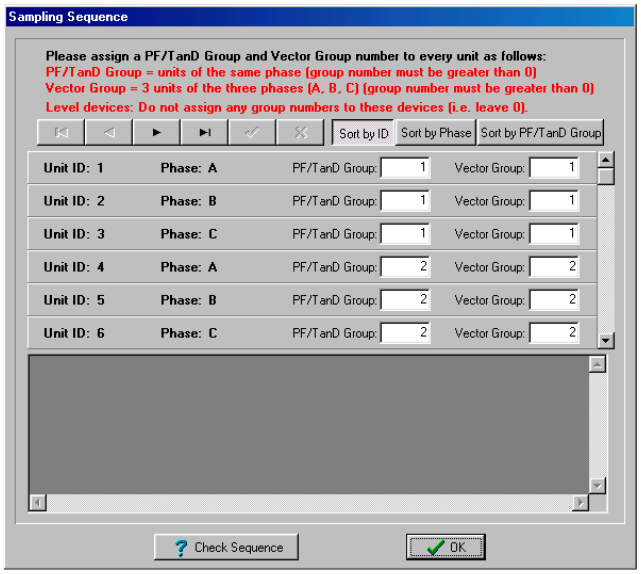
NOTE: *After any configuration changes to units in the monitoring set have been made, the sampling sequence should be verified by clicking the Check Sequence button. Keep in mind that InsuLogix® B Monitoring should be stopped and restarted in order to use the new configuration and sampling sequences*

All non-Level type units must be assigned to a PF/TanDelta group for sampling and can be optionally assigned to a Vector group for sampling, as shown in the following figure.



TanDelta and Vector Groups

Units are assigned to a PF/TanDelta group and Vector group by specifying group numbers > 0 (units with the same number are grouped together). For example, if units from different phases are assigned to the same PF/TanDelta group (InsuLogix® B will make the necessary angle adjustment before computing the Power Factor) then the user may desire to not assign the units to a vector group. This is accomplished by entering a zero (0) in the Vector Group field.


Sampling Sequence
Please assign a PF/TanD Group and Vector Group number to every unit as follows:
PF/TanD Group = units of the same phase (group number must be greater than 0)
Vector Group = 3 units of the three phases (A, B, C) (group number must be greater than 0)
Level devices: Do not assign any group numbers to these devices (i.e. leave 0).
Sort by ID
Sort by Phase
Sort by PF/TanD Group
Unit ID: 1 Phase: A PF/TanD Group: 1 Vector Group: 1
Unit ID: 2 Phase: B PF/TanD Group: 1 Vector Group: 1
Unit ID: 3 Phase: C PF/TanD Group: 1 Vector Group: 1
Unit ID: 4 Phase: A PF/TanD Group: 2 Vector Group: 2
Unit ID: 5 Phase: B PF/TanD Group: 2 Vector Group: 2
Unit ID: 6 Phase: C PF/TanD Group: 2 Vector Group: 2
Check Sequence
OK

Sampling Sequence

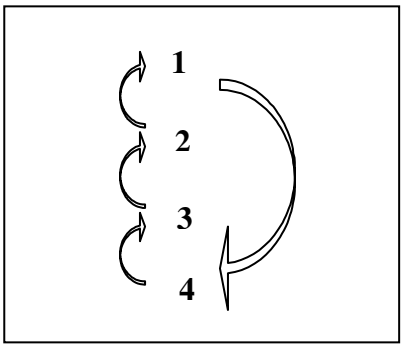
PF/TanDelta & Lightning Arrester Sampling

Every non-Level type unit must belong to a PF/TanDelta group The units in a PF/TanDelta group do not have to be from the same phase as the software will make the

rotational adjustment before computing the PF/TanDelta. A unit is assigned to a PF/TanDelta group by specifying a PF/TanDelta group number > 0 for the unit.

Lightning arresters must be assigned to their own individual group as well. The leakage current of the arrester will then be trended. The leakage current alarm point for each arrester is individually set as shown in section

During PF/TanDelta sampling, InsuLogix® B Monitoring will cycle through all of the units each PF/TanDelta group and obtain voltage measurements so that the *relative* TanDelta between units in a PF/TanDelta group can be computed. For example, if units 1, 2, 3 and 4 are grouped together, then unit 2 will be sampled with reference to unit 1, unit 3 to 2, unit 4 to 3 and unit 1 with reference to unit 4 as illustrated in the following figure.

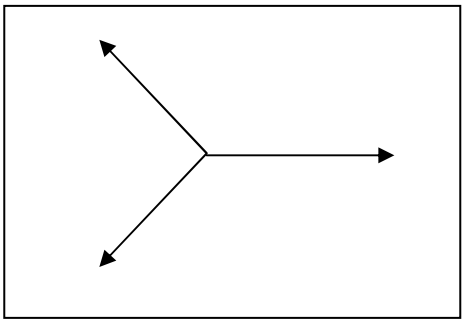


TanDelta Sampling

Vector Sampling

Not all units must belong to a Vector group - a Vector group consists of three units from the three different phases. A unit is assigned to a Vector group by specifying a Vector group number > 0 for the unit. Note that only one unit per phase may belong to a Vector group.

During Vector sampling, InsuLogix® B Monitoring will cycle through all of the units per Vector group and calculate the vector representation of the 3 units in the Vector group. The phase shifts (angles in degrees) between the units are stored.



Vector Sampling

Lightning Arrester & Level Sampling

Level units of the same type, such as lightning arresters may belong to a specific group if the user wishes to trend them as well as set individual alarm points for each level input.

NOTE: *Both the PF/TanDelta and Vector group should be set to 0 (zero) for a level type device.*

Verifying the Sampling Sequence

After all PF/TanDelta and Vector groups have been assigned, click on the *Check Sequence* button to verify that the assignments are valid. If there are any errors in the sampling sequence, the error messages will appear in the list box. If the units in a PF/TanDelta group are not associated with the same phase, a warning message "Inconsistent Phase" is shown so the user can verify that this is not an error.

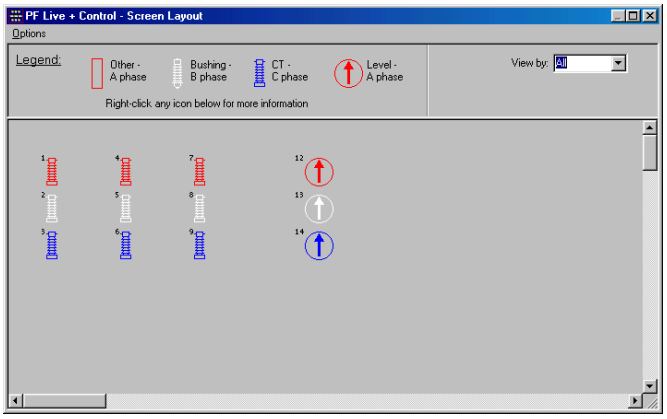
Make any necessary corrections and click the *Check Sequence* button again. A "Saved OK" message will appear if the sampling sequence was verified and saved.

Screen Layout

Menu: *Configuration – Screen Layout*

The user can configure the screen layout, and add descriptive text on the InsuLogix® B Monitoring display.

All unplaced units will appear at the top of the screen (just below the legend) and must be placed by dragging them (left-click and move mouse) onto the main layout area. Units can be grouped or organized in a layout that makes sense to the user and represents the physical layout of the units in the substation. Units already placed can be dragged into a new position – please note that the layout uses a small grid and all units will be aligned with this grid.



InsuLogix® B Screen Layout

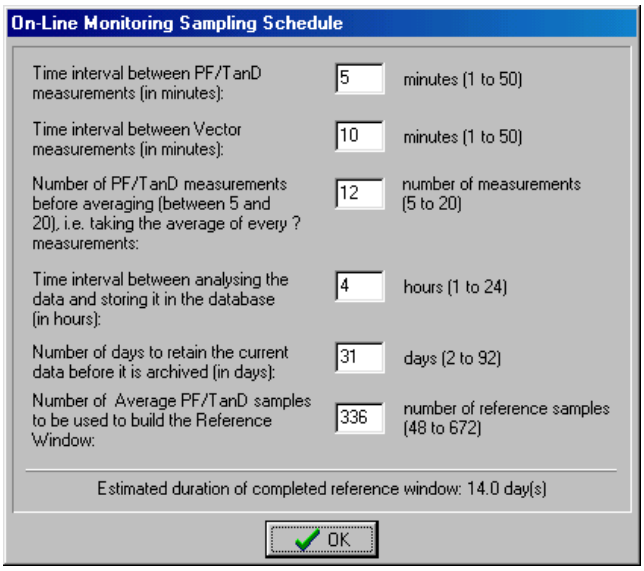
NOTE: *The UnitID is shown at the upper left corner of the symbol / icon.*

To add descriptive text anywhere on the layout, left click on an open space and add the text. Text can be dragged into a new position, and can also be edited or deleted (right click the text for options).

To close the layout screen after placing all the units, click the ☒ button in the title bar of the window (upper right corner).

Sampling Schedule

Menu: *Configuration – Sampling Schedule*


On-Line Monitoring Sampling Schedule
Time interval between PF/TanD measurements (in minutes):
5
minutes (1 to 50)
Time interval between Vector measurements (in minutes):
10
minutes (1 to 50)
Number of PF/TanD measurements before averaging (between 5 and 20), i.e. taking the average of every ? measurements:
12
number of measurements (5 to 20)
Time interval between analysing the data and storing it in the database (in hours):
4
hours (1 to 24)
Number of days to retain the current data before it is archived (in days):
31
days (2 to 92)
Number of Average PF/TanD samples to be used to build the Reference Window:
336
number of reference samples (48 to 672)
Estimated duration of completed reference window: 14.0 day(s)
OK

InsuLogix® B Sampling Schedule

Through the sampling schedule, the user controls how often InsuLogix® B will sample, calculate averages, store data, and analyze data. The different scheduler variables are:

- Time interval between PF/TanDelta measurements: This specifies the frequency of PF/TanDelta sampling, e.g. a value of 5 means that PF/TanDelta sampling will take place every 5 minutes. All measurements are kept in memory until averaging, when it will be stored to the database.
- Time interval between Vector measurements: This specifies the frequency of Vector sampling, e.g. a value of 10 means that Vector sampling will take place every 10 minutes. All measurements are kept in memory until averaging when it will be stored to the database.
- Number of PF/TanDelta measurements before averaging: This specifies how many PF/TanDelta samples the system will collect before calculating the average of all PF/TanDelta and Vector samples and storing the average values to the database. For example, if PF/TanDelta sampling is done every 5 minutes and averaging after every 12 samples, then an average value will be added to the database every hour (5 * 12 = 60 minutes) per unit sampled. Please note that this setting also controls the averaging of Vector samples, which is every two hours (10 * 12 = 120 minutes), even though the parameter is specified in PF/TanDelta samples.
- Time interval between analyzing the data: This specifies the execution frequency of the analysis routine (in hours). The analysis routine uses the stored average values in the database to calculate new condition values for the units in the monitoring set. These condition values are then stored to the database.
- Number of days to retain the current data: This duration interval (in days) specifies when the data will be moved from the current database to an archived database. Doing this will control the size and volume of data in the current database. The backup function is executed once a day to determine if archiving is required and will also automatically copy the current database to another database file as a backup on a daily basis.
- Number of average PF/TanDelta samples to be used to build the Reference Window: This specifies the number of average PF/TanDelta values that will be contained in the reference window. The reference window is used during the analysis routine to compare current data against reference window data – this enables the analysis algorithms to detect shifts or trends in the data. Keep in mind that the reference window only applies to PF/TanDelta measurements, and not Vector measurements. For the values specified in previous figure, the duration of the reference window can be calculated as follows: 336 samples * 12 (averaging of 12 samples) * 5 (one sample every 5 minutes) = 20,160 minutes = 336 hours = 14 days. This number also indicates how long it will take to initially build the reference window.

NOTE: *The factory default for this setting is 128. We recommend that this setting be increased by 128 every 3 months during the first year of operation to create a reference window that covers 4 seasons of data.*

Diagnostics

InsuLogix® B Control contains a comprehensive set of diagnostics tools to assist the user while installing the InsuLogix® B monitoring system, or to troubleshoot a defective component of the system.

NOTE: *The diagnostics tools communicate directly with the units and use the physical channel number to which a unit is connected.*

NOTE: *The diagnostics tools will be disabled if InsuLogix® B Monitoring is already running. This is necessary because running both InsuLogix® B Control Diagnostics and InsuLogix® B Monitoring can cause a conflict through simultaneous access to the hardware resources.*

A/D Card

Menu: *Diagnostics – A/D Card*

The A/D card diagnostics tool provide the user with the functionality to test the two major functions of the A/D card and will display the results returned by the A/D card on the screen. The two functions are:

Test D/O:	Test the digital output functionality of the card.
Test A/I:	Test the analog input (analog to digital converter) – the user needs to provide a channel number which to sample.

Signals

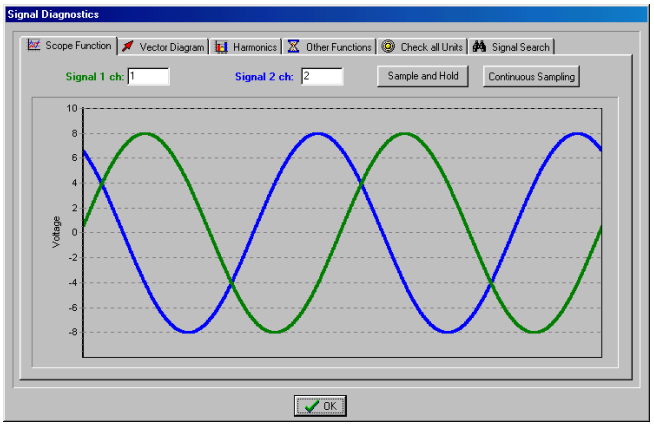
Menu: Diagnostics - Signals

Signal diagnostics is the most important diagnostics tool. The various utilities in this tool provide the user with the functionality to troubleshoot incorrect signals, bad wiring, and various other problems that could affect the quality of the signals sampled.

Scope Function

The scope function plots any two signals sampled simultaneously on a voltage vs. time graph. You can take a snapshot sample by clicking on *Sample and Hold* or let the function continuously sample and plot the two channels by clicking *Continuous Sampling* (click / toggle *Continuous Sampling* again to stop continuous sampling).

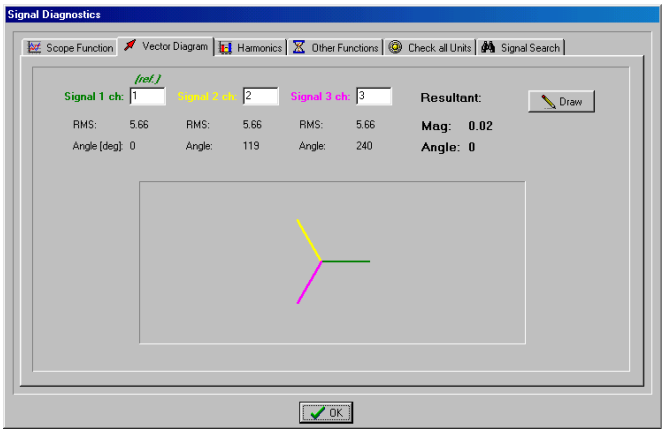
NOTE: *Make sure that Continuous Sampling is stopped before moving on to perform other functions, or before exiting the diagnostics tools.*



Signal Diagnostics – Scope Function

Vector Diagram

This function will draw a vector diagram of three signals sampled, as well as calculate and draw the resultant vector of the three signals. Click *Draw* to sample and draw the signals. The primary benefit will be to confirm the phase orientation of three signals from different phases.



Signal Diagnostics - Vector Diagram

Harmonics

This function will sample one channel and draw the different harmonic components of the signal in a bar-chart format.

Other Functions

Using this tool, the user can sample any two channels with the same phase orientation and view the calculated maximum, RMS, and mean of the two signals, as well as the relative PFand TanDelta calculations (as a percentages) and relative capacitance between the two signals.

The temperature and humidity values can also be read from the temperature and humidity channels, if configured. The DC voltage reading from a Level channel can be sampled as well as writing a test value to the two Analog Output channels.

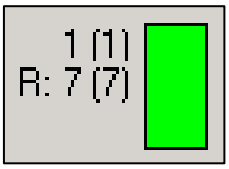
Check All Units

This is a very important function to verify the signals from all units in the monitoring set at a glance. Please note that this function uses the unit configuration as specified for the monitoring set (PF/TanDelta groups, etc.).

You can take a snapshot sample by clicking on *Sample and Hold* or let the function continuously sample and update the display by clicking *Continuous Sampling* (click / toggle *Continuous Sampling* again to stop continuous sampling).

The UnitID and channel number of the unit and the reference unit are displayed (note that every unit is sampled with another unit as a reference).

e.g. UnitID 1 (channel 1) is sampled with reference to UnitID 7 (channel 7). The green rectangle is an indication of the signal quality.



The various signal quality indicators are:

Green	Signal OK
Red	Signal down
Yellow	The signal is OK, but the reference unit's signal is down. This means that no PF/TanDelta calculation can be made for the unit.
Blue	Both signals are OK, but the calculated PF/TanDelta is out of range.

Signal Search

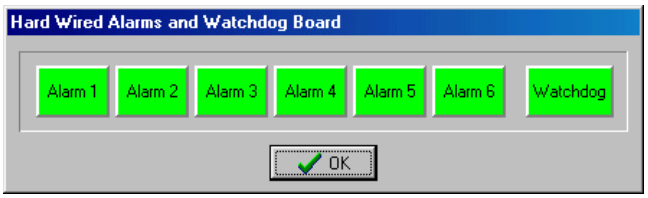
This function will scan the range of channels specified and will provide a list of the active channels that were found. It will display the type of channel (AC or DC) and the RMS and Mean values of the samples collected and an indication of the frequency of the signal.

NOTE: *Make sure that Continuous Sampling is stopped before moving on to perform other functions, or before exiting the diagnostics tools.*

Hard Wired Alarms

Menu: *Diagnostics – Hard Wired Alarms*

The InsuLogix® B system can be connected to external alarms that can be activated by InsuLogix® B (called hard-wired alarms). The Hard Wired Alarms diagnostics tool provides the functionality to test these connections.



Test Hard Wired Alarms

Click any alarm box to toggle the connection from open to close (or open again) – lime indicates a open (normal) connection and red indicates an closed (alarm) connection. The *watchdog* box toggles the signal to the watchdog board in the InsuLogix® B cabinet that is normally in the closed state (red).

Communications

Menu: *Diagnostics – Communication*

The Communication Diagnostics tool is not used on the InsuLogix® B system unless the fax and/or e-mail capability options are utilized.

Utilities

From the InsuLogix® B Control toolbar or menu bar, various other utility functions are available.

View or Print Monitoring Set

Menu: *Utilities – View or Print Monitoring Set*

This utility function will generate a report (to be viewed, saved, or printed) of all units in the monitoring set.

Import or Export Configuration and Settings

Menu: *Utilities – Import or Export Configuration and Settings*

This utility function allows the user to export / import the complete InsuLogix® B system configuration – all the settings files as well as the configuration (monitoring set) database. The configuration files and database are compressed into a single *.zlb file that will be by default saved to a floppy disk.

To import a InsuLogix® B system configuration from another already configured system, click *Import* and locate the *.zlb file containing the configuration files.

Launch Graphs

Menu: *Utilities – Launch Graphs*

This will launch the InsuLogix® B Graphs program.

Advanced Tools

⚠ CAUTION

THESE FUNCTIONS CAN SERIOUSLY IMPACT THE PERFORMANCE OF THE INSULOGIX® B SYSTEM AND SHOULD ONLY BE USED BY QUALIFIED PERSONNEL.

Reset Reference Data Base

Menu: *Utilities – Reset Reference Data Base*

This advanced utility will reset the current database file (…SOS\Data\pescdata.gdb) for the InsuLogix® B system, including the reference windows, to an empty database file.

Reset Archive Data Base

Menu: *Utilities – Reset Archive Data Base*

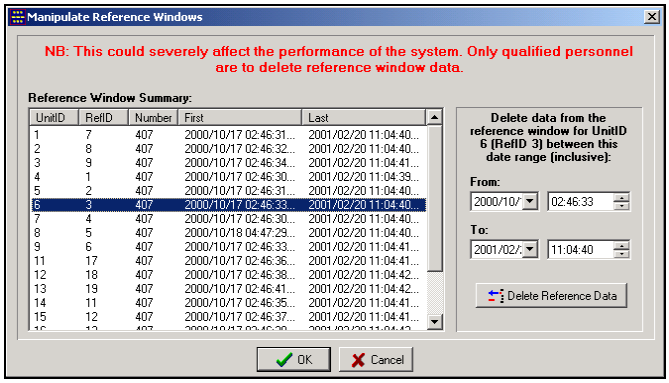
This advanced utility will reset the backup database file (…SOS\Data\pescold.gdb) for the InsuLogix® B system to an empty database file.

Manipulate Reference Windows

Menu: *Utilities – Manipulate Reference Windows*

This advanced utility provides the user with the ability to erase all, or part of a reference window for a specific unit based on the data range specified.

It is very important that the reference window per unit should contain data that can be viewed as "normal" condition data. If a reference window contains a portion of data that was influenced by factors other than normal operation, like severe weather or bad wiring, this data can be deleted. Use InsuLogix® B Graphs to view the data in a unit's reference window so that the abnormal data range can be determined before using this function.



Manipulate Reference Windows

Delete system logs

Since the adcard.log, comm.log, and reboot.log will accumulate historical status information over time, this function will remove these log files so that they can be replenished with new status information.

InsuLogix® B Monitoring

This is the main InsuLogix® B executable program which performs the continuous monitoring of devices in the substation.

Before Running Monitoring

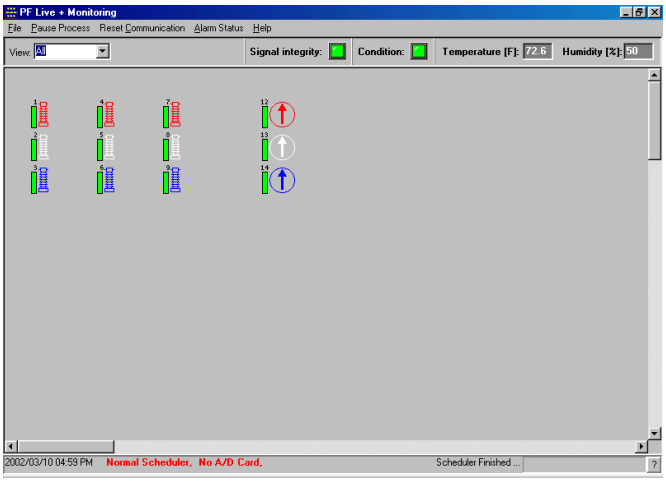
InsuLogix® B Monitoring is designed for continuous monitoring, not requiring any user interaction. Because of this, it is very important that the system was correctly and completely configured using InsuLogix® B Control. Since InsuLogix® B Monitoring must automatically start-up with Windows, ensure that the start-up mode in Control - System Settings is set to *With Windows*.

When InsuLogix® B Monitoring is started for the first time, perform these manual checks on the running system:

- Check that Monitoring starts up automatically with Windows and that there is are no prompts for user input.
- Check the signal integrity of all units for normal operation.
- Check that Monitoring is sampling and storing data (a message at the bottom right hand corner of the screen that changes will indicate this is operating correctly).

Main System Display

The following figure shows a typical InsuLogix® B Monitoring display:



InsuLogix® B TanDelta Monitoring System – Main Display

System Summary

Monitoring Screen - Top Section

At the top of the screen, just below the menu options, the following information or options are available:

- View - The user has the option to view all units or to select to view only units in a certain PF/TanDelta group, Phase, Type of Unit, or in a certain Condition

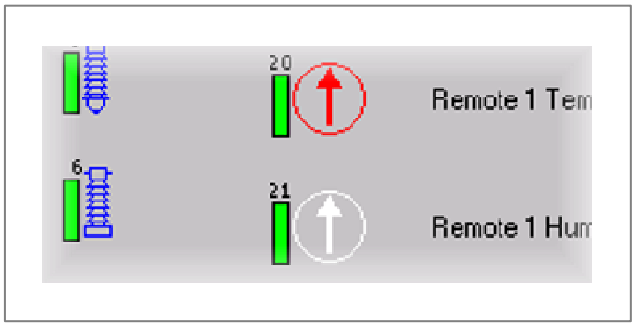
- Signal Integrity - A green square (LED) indicates that there are no problems with the signal integrity of any of the units in the monitoring set. A red square will indicate that a unit has signal integrity problems.
- Condition - This square indicates a summary of the overall condition of the units in the monitoring set. Green will indicate that all units are in a green condition, yellow will indicate that at least one unit has a yellow (warning) condition, while red will indicate that at least one unit has a red (alarm) condition. Gray indicates that the analysis function has not been able to determine a condition value.
- Temperature - The current temperature reading.
- Humidity - The current relative humidity reading.

Monitoring Screen - Bottom Section

In the status bar at the bottom of the screen, the following information is displayed:

- Current date and time
- Any system warnings, i.e. when the available disk space falls below the alarm limit
- Progress bar and activity indicator (right hand corner) – shows the current activity (i.e. sampling, analyzing, storing data, etc.) as well as a completion progress indicator

Unit Layout

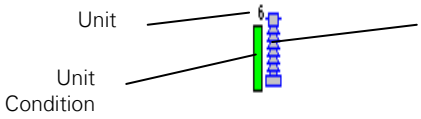


Monitoring Screen - Unit Layout

The main portion of the monitoring screen contains the unit layout and unit specific information. All units in the monitoring set, as well as any text added to the layout, are displayed as positioned in InsuLogix® B Control.

By right-clicking any unit indicator icon, full information on the particular unit is displayed.

The following information is available on the screen:



Unit Indicator, showing type, phase, and signal integrity

Unit Condition

The unit condition is displayed as follows:

Green (normal) Condition:	The rectangle will be green, with a yellow filling indication that the unit is approaching a warning condition state. A completely green rectangle indicates a condition value of 0.
Yellow (warning) Condition:	The rectangle will be yellow, with a red filling indicating how far the unit is approaching the alarm state.
Red (alarm) Condition:	The rectangle will be red.
No Condition Available:	A gray rectangle indicates that the condition value for the unit is not available. This could be because the system is still capturing data for the unit's reference window.
Last Know Condition:	A dark green, yellow or red rectangle indicates that the system has not currently sampled and analyzed the unit, and is therefore only displaying the "last known" condition status.

NOTE: *A yellow condition means there is some concern about the condition of a unit and the user is required to investigate the particular unit. Conventional off-line tests are highly recommended. A red condition means the probability of a unit failing is dangerously high.*

Signal Integrity

Note that no data will be stored to the database when signal integrity problems are experienced with a particular unit (this ensures the integrity of the data stored). The three main types of signal integrity problems are:

Signal Down:	The signal from a unit is classified as "down" when the RMS value falls outside specified limits, or the mean value exceeds a certain limit.
Reference Signal Down:	The PF/TanDelta value for a unit could not be calculated because the unit that is used as reference when sampling for the particular unit is down.
PF/TanDelta or Level Out of Range:	If the calculated PF/TanDelta or level value falls outside specific limits, the values are not stored to the database.

Unit Indicator

The following table shows the various unit indicators, display type, phase and signal integrity information:

	CT	Bushing	Level	Other
A / Red Phase - Signal OK				
B / White Phase -Signal OK				
C / Blue Phase - Signal OK				
Signal Down				
Ref. Signal Down			N/A	
TanDelta or Level Out of Range				
A/D Card Error				
Level Warning State	N/A	N/A		N/A
Level Alarm State	N/A	N/A		N/A

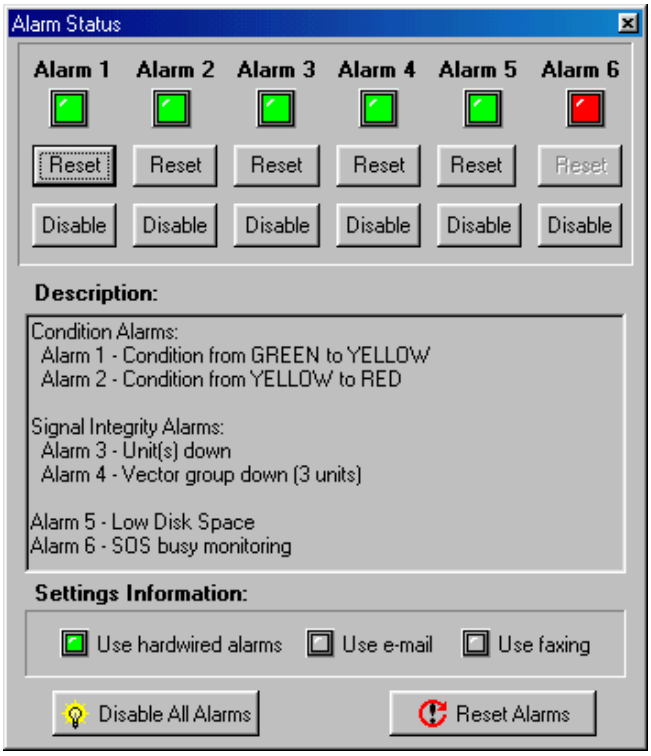
Unit Indicator Table

System Alarms

Menu *Alarm Status*

On the alarm status screen, the user can view the various system alarms, enable or disable an alarm, or reset an alarm. The various system alarms are:

Alarm 1	Condition	The condition of a unit changes from green to yellow.
Alarm 2	Condition	The condition of a unit changes from yellow to red.
Alarm 3	Signal Integrity	The signal from a single unit is down.
Alarm 4	Signal Integrity	The signals from a vector group (3 units) are down.
Alarm 5	Storage	The available disk space on the computer is below the specified percentage.
Alarm 6	System Status	This is not an alarm, but rather an indication that the system is currently running. When InsuLogix® B Monitoring is running, the contact for this alarm is normally closed (Operational) and will open (Alarm) if the Monitoring program stops (e.g. when the operating system crashes or the PC hangs).



Alarm Status Display

Each of the six alarms can individually be reset or disabled or all the alarms can be simultaneously disabled or reset. A green square (LED) indicates the alarm is enabled and not activated, a red LED indicates the alarm is activated, while a gray LED indicates that the alarm is disabled.

NOTE: *The user will have to enter the system password before allowed to disable or reset any alarm.*

Other Functions

Pause / Resume Process

Menu *Pause Process* or *Resume Process*

The user can manually pause or resume the monitoring process. Access to this functionality is restricted and the user will have to enter the system password.

Reset Communications

Menu *Reset Communications*

This function is not utilized on the InsuLogix® B system unless the Modem option is included.

The Monitoring Process

The sequence of execution is controlled by the sampling schedule as configured in InsuLogix® B Control. The major processes are briefly described.

Sampling & Averaging Process

Based on the sampling schedule, InsuLogix® B Monitoring samples all units in the monitoring set at regular intervals. Three types of sampling will happen:

- PF/TanDelta Sampling - All non-level type units are sampled per PF/TanDelta group. Sampling occurs in pairs – a unit is always sampled with reference to another unit – forming a closed loop in the PF/TanDelta group. The voltage magnitude of the two signals, as well as the relative PF/TanDelta is calculated and stored in memory.
- Vector Sampling - All non-level type units are sampled per Vector group. The voltage magnitudes and angles between the three signals are calculated and stored in memory.
- Level Sampling - All level type units are sampled, and the DC voltage at the devices are measured and converted to count values and stored in memory.

All measurements are kept in memory until the number of samples specified for averaging has been reached, then the average of all the samples for the unit is calculated and stored in the disk resident database file.

Analysis Process

Based on the sampling schedule, InsuLogix® B Monitoring analyzes the stored data and calculates new condition values for the units in the monitoring set.

PF/TanDelta Analysis

The condition values of all non-level type units are based on a set of statistical tests performed on the PF/TanDelta data in the current database. These test include:

- A current trend analysis, looking at the last several days of data.
- A long-term trend analysis, comparing current data with the reference window data.
- A seasonal slope estimator test.
- A swing indicator test, testing for increased variance in the data.

Please note that the PF/TanDelta analysis uses a reference window of data built per unit. This implies that the quality of the analysis depends on the quality of data in the reference window - this data should represent data under "normal" / non-failing conditions. When starting monitoring of a new unit, data for the reference window needs to be collected before the full set of tests can be performed.

Level Analysis

- The condition value of a level unit is based on the alarm limit for the unit specified in InsuLogix® B Control. The alarm and warning tests are performed on the most recent 20% of the samples in the current database. If any of these samples is in the alarm state (> 90% of the alarm limit), the condition value for the unit is set to 95 – a red condition. If any of these samples is in the warning state (> 70% of the alarm limit), the condition value is set to 75 – a yellow condition.

If a level unit is not in an alarm or warning state, a seasonal slope analysis is performed on all the samples in the current database, and a condition value between 0 and 70 is assigned to the unit, based on the analysis.

Dynamic Analysis Scheduling

The analysis process will dynamically change the sampling schedule (controlling the sampling, averaging, and analysis processes) depending on the highest condition value calculated or the largest change in condition values detected.

The following table gives the dynamic schedule based the condition values (C) calculated and the sampling schedule as specified in InsuLogix® B Control. For the purpose of this example, a PF/TanDelta sampling rate of 5 minutes, an averaging rate of 12 samples, and an analysis rate of 4 hours are assumed.

Condition Value (C)	Dynamic Averaging (Av)	Dynamic Analysis (An)
C <= 40	Av = as specified e.g. 5 x 12 = every hour	An = as specified e.g. every 4 hours
40 < C <= 60	Av = as specified e.g. 5 x 12 = every hour	An = An / 2 e.g. every 2 hours
C > 60	Av = Av / 2 e.g. 5 x (12/2) = every 30 minutes	An = An / 4 e.g. every hour
$(C_{now} - C_{last}) > 30$	Av = Av / 2 e.g. 5 x (12/2) = every 30 minutes	An = An / 4 e.g. every hour

Archive Process

The archive process will execute once a day (normally at midnight). During this process, the backup database file (pescold.gdb) is updated with data from the current database file (pescdata.gdb). The current database file is also copied to the SOS\Backup\ folder as another backup and renamed pescdata.bak.

Depending on the archive days setting in the sampling schedule (between 2 and 92 days), a new archived database file (file name format SOSyyyymmdd.gdb) will be created from the backup database file and stored in the SOS\Backup\ folder each time this archiving interval is reached. The backup database file is then initialized to an empty state.

Reporting Process

Depending on the reporting settings in InsuLogix® B Control, warning, summary or detail reports are generated (normally at midnight). Reports are generated as text files and stored in the default SOS folder. The text files are called "warning.txt", "summary.txt" and "detail.txt" respectively.

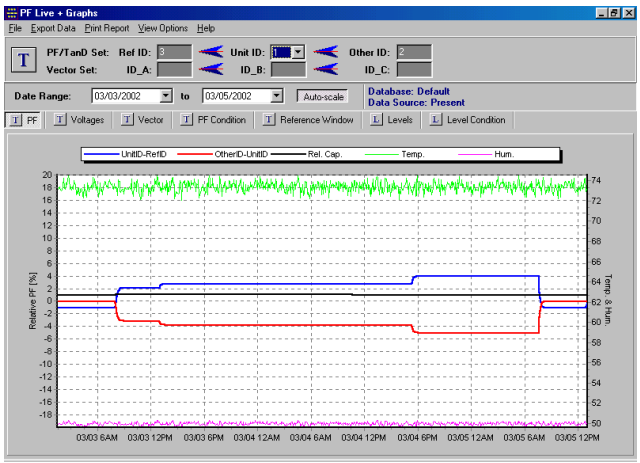
A warning report contains status information on all activated alarms, signal integrity problems, or units that have a yellow or red condition value. A summary report contains information about the whole system (i.e "The condition of all monitored units is GREEN."). A detail report contains information on every unit in the monitoring set.

InsuLogix® B Graphs

InsuLogix® B Graphs is the data investigation utility in the InsuLogix® B software suite. This program gives the user the ability to view stored operational data in graphical form.

Main Display

The following figure shows a typical InsuLogix® B Monitoring display:


PF Live + Graphs
File Export Data Print Report View Options Help
PF/TanD Set: Ref ID: Unit ID: Other ID:
Vector Set: ID_A: ID_B: ID_C:
Date Range: 03/03/2002 to 03/05/2002 Auto-scale
Database: Default
Data Source: Present
PF Voltages Vector PF Condition Reference Window Levels Level Condition
UnitID-RefID OtherID-UnitID Rel. Cap. Temp. Hum.
Relative PF [%]
Temp. & Hum.
03/03 6AM 03/03 12PM 03/03 6PM 03/04 12AM 03/04 6AM 03/04 12PM 03/04 6PM 03/05 12AM 03/05 6AM 03/05 12PM

InsuLogix® B Graphs Screen

The main display consists of the following areas:

UnitID Selection

UnitID Selection – Non-Level Units

The top section of the screen allows the user to select a unit for which data will be displayed. The user can select a unit by clicking the dropdown list (Unit ID:). Data for the selected unit will be displayed in all the graphs. The reference unit, other unit (the unit that is using the selected unit as a reference) and the vector group information will also be displayed.

When viewing level data or level condition data, another UnitID selection input is used.

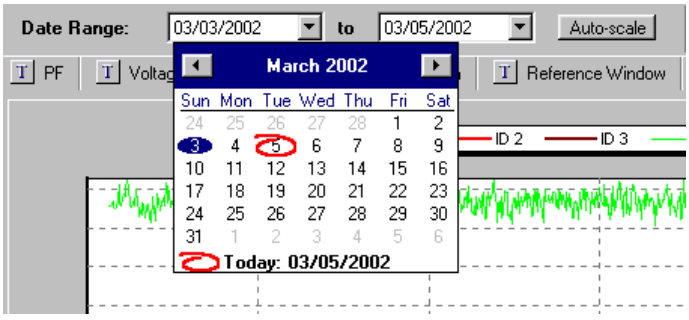
UnitID Selection – Level Units

Up to three units can be selected. To remove a unit from the graphs, click the relevant erase button.

Date Range Selection

Date Range Selection

This box allows the user to specify a date range for which data will be displayed. By clicking the down arrow on a date selection box, a calendar will be displayed from which the user can select a date.



Selecting a Date

All graphs will automatically be scaled to fit the date range specified. To scale the graphs to fit the available data in the entire graph area, click the *Auto-scale* button (click again to scale to the specified date range).

Graphs - General

Available Types of Graphs

Various graphs are available to the user – to view a graph, select (click) it from the list of available graphs.

All graphs are displayed as line-charts, with the date on the horizontal (bottom) axis and the relevant value on the vertical (left and/or right) axes.

All graphs can be manually moved left, right, up or down. This is done by right dragging with the mouse on the graph (right-click, hold the mouse button down and move the mouse).

To manually zoom into an area of a graph, left drag a box around the area from top-left to bottom-right (left-click the top-left corner of the area, hold the mouse button down, move the mouse to the bottom-right corner and release the mouse button again).

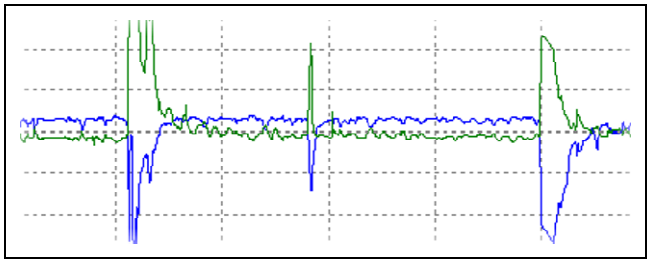
While the mouse cursor is in a graph area, holding down the *shift key* will show crosshairs, enabling the user to easily read the x-axis and y-axis values at a particular point.

To reset the display of a graph (zoom out and move to original position) after manually moving and/or zooming a graph, left drag a box anywhere on the graph from bottom-right to top-left (left-click anywhere on the graph, hold the mouse button down, move the mouse to the top and left, and release the mouse button again).

Types of Graphs

Non-Level Type Units

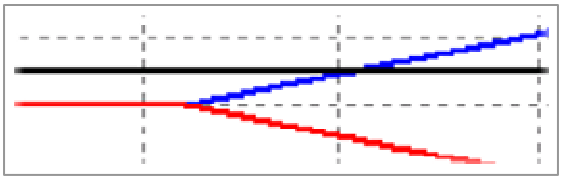
PF/TanDelta



Typical PF/TanDelta Data

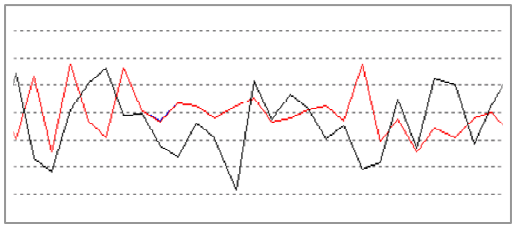
This graph plots PF/TanDelta data (left-axis), relative capacitance (left-axis) and the temperature and humidity data (right-axis), during the time interval selected.

The PF/TanDelta data for the selected unit and reference pair is drawn in blue, while the PF/TanDelta data of the unit and other pair is drawn in red. This graph enabled the user to search for visible trends in the data. Because of the closed-loop, relative sampling in a PF/TanDelta group, one would expect a "butterfly / mirror image" trend if the selected unit's isolation is deteriorating. If only one of the lines shows a trend (i.e. it is not mirrored by the other line) it might indicate that either the reference unit or the other unit is failing.



Voltages

This graph plots sampled voltages of the selected unit; its reference unit and the unit referencing the selected unit ("other" unit), over time.



Vector

The vector graph plots the angles of the three units in a Vector group, with reference to the first unit, over time. Note, that only the Phase B and C angles are drawn as they are referenced to Phase A.

PF/TanDelta Condition

This graph plots the calculated condition value of the selected unit. The humidity and temperature readings are also shown.

Reference Window

This very important graph shows the values that are used in the analysis of PF/TanDelta data. This includes the reference window data for the selected unit, as well as the current (up to the number of data points in the reference window) PF/TanDelta data for the unit.

The date/time stamps of the first and last record in the reference window are displayed. Note that no horizontal / bottom axis is visible for this graph, because the reference window data and present PF/TanDelta data will have different date/time intervals.

Level Type Units

Levels

This graph plots level values (in counts) of up to three selected units. The humidity and temperature readings are also shown (scaled to the right-axis).

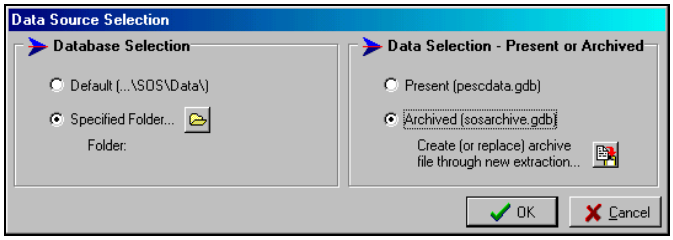
Level Condition

The Level Condition graph plots the calculated condition values of up to three level units for the selected time interval. The humidity and temperature readings are also shown (scaled to the right-axis).

Changing the Data Source

Menu *File – Change Data Source*

The user can specify the data source to be used by InsuLogix® B Graphs. This will determine the data used in all graphs, reports, and export functionality.



Data Source Selection

Database Selection

InsuLogix® B Graphs can use the default (active) database (in the …\SOS\Data folder) or another specified folder containing the database files. Note that when another folder is specified, it must contain the pescandb.gdb file.

To specify another database location / folder, click the button and browse to the folder containing the database files.

Data Selection – Present or Archived

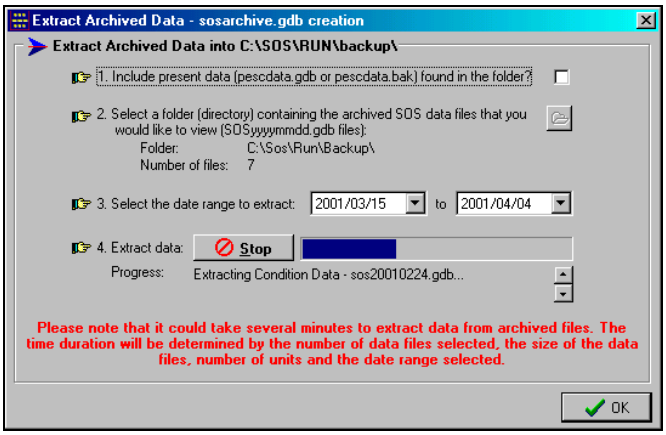
The user can also specify if present or archived data should be used as the data source. Present data is stored in the pescdata.gdb database file, while archived data is extracted into an archive source file called sosarchive.gdb, which is then used by InsuLogix® B Graphs.

When archived data is selected, InsuLogix® B Graphs will use the archive source file in the current database folder (see Database Selection). If data has not been extracted before, or if the user wants to use newly extracted data, click on the button that will show the InsuLogix® B Graphs archived data extraction utility.

Extract Archived Data

NOTE: *To use archived data as a data source for InsuLogix® B Graphs, the archived data first need to be extracted into an archive source file (sosarchive.gdb).*

InsuLogix® B Graphs will extract all valid SOS database files found in a specified directory. A database file called sosarchive.gdb will be created in the current database folder (see Database Selection) and will be used by InsuLogix® B Graphs if the user specifies archived data to be used.


Extract Archived Data - sosarchive.gdb creation
Extract Archived Data into C:\SOS\RUN\backup\
1. Include present data (pescdata.gdb or pescdata.bak) found in the folder?
2. Select a folder (directory) containing the archived SOS data files that you would like to view (SOSyyyymmdd.gdb files):
Folder: C:\Sos\Run\Backup\
Number of files: 7
3. Select the date range to extract: 2001/03/15 to 2001/04/04
4. Extract data: Stop
Progress: Extracting Condition Data - sos20010224.gdb...
Please note that it could take several minutes to extract data from archived files. The time duration will be determined by the number of data files selected, the size of the data files, number of units and the date range selected.
OK

Archived Data Extraction Utility

To extract archived data, follow these steps:

1. Specify if present data should also be included in the archive source file (sosarchive.gdb) or not.
2. Specify the folder containing the archived database files to be extracted by clicking the button. All valid SOS archive files (sos*.gdb), as well as present data files if so specified in step 1, in this folder will be extracted.
3. Specify the date range for data to be extracted - only data within this range will be extracted and included in the archive source file.
4. Click the *Extract* button to start the extraction process.
5. Click *OK* when done.

While the system is busy extracting data, the progress of the extraction process will be indicated, as well as the data type and filename currently being extracted. The user can scroll through the progress information by clicking the up or down arrows.

Progress Information

To cancel the extracting process, click the *Stop* button.

NOTE: *If the extracting process is stopped or cancelled, the archive source file could be invalid or only contain partial data.*

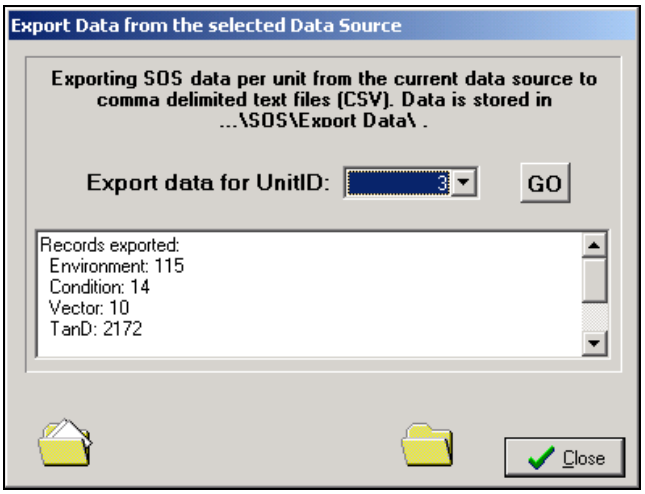
Export Data

InsuLogix® B Graphs can export data in comma separated variables (CSV) text files to be used in application like Microsoft Excel.

Export Data to CSV Files

Menu *Export Data - …per unit to CSV files*

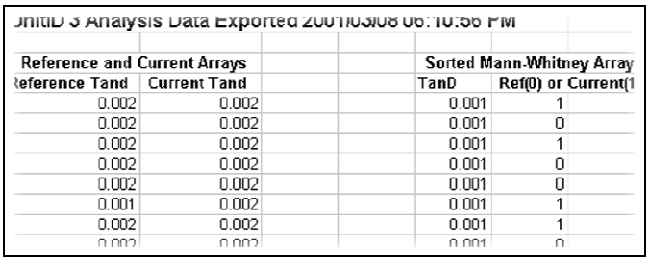
This function will export data from the current data source (either present data or archived data) to CSV (comma-delimited) text files. Data is exported for a *specified unit* and is stored in *.csv files in the folder …SOS\Export Data\.


Export Data from the selected Data Source
Exporting SOS data per unit from the current data source to comma delimited text files (CSV). Data is stored in ...\SOS\Export Data\ .
Export data for UnitID:
3
GO
Records exported:
Environment: 115
Condition: 14
Vector: 10
TanD: 2172
Close

Export Data to CSV Files

The data files are named sos_*x*_*type*.csv, where *x* indicates the UnitID and *type* indicates the data type in the file (e.g. sos_1_condition.csv).

Note that a file with an *analysis* type is also created. This file contains the PF/TanDelta data used in the analysis to calculate the condition value of the selected unit. As the PF/TanDelta data is compared with data from the reference window, both the present data and reference data is exported. One of the statistical tests in the analysis uses a sorted array containing both present and reference data – this array (Mann-Whitney array) is also exported.



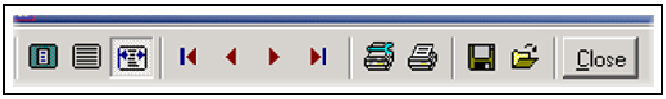
UnitID 3 Analysis Data Exported 2001/03/08 06:10:56 PM

Reference and Current Arrays		Sorted Mann-Whitney Array	
Reference TanD	Current TanD	TanD	Ref(0) or Current(1
0.002	0.002	0.001	1
0.002	0.002	0.001	0
0.002	0.002	0.001	1
0.002	0.002	0.001	0
0.002	0.002	0.001	0
0.001	0.002	0.001	1
0.002	0.002	0.001	1
0.002	0.002	0.001	0

Example of analysis data exported

Reports

All reports are previewed on the screen, from where the user can select to print or save it (reports are saved in QuickReport format – QRP).



Report Preview Toolbar

The buttons on the preview toolbar are, from left to right:

- Zoom to Fit
- Zoom to 100%
- Zoom to Width
- First Page
- Previous Page
- Next Page
- Last Page
- Printer Setup
- Print
- Save Report
- Load Report
- Close the Preview

Conditions Report

Menu *Print Report - Conditions*

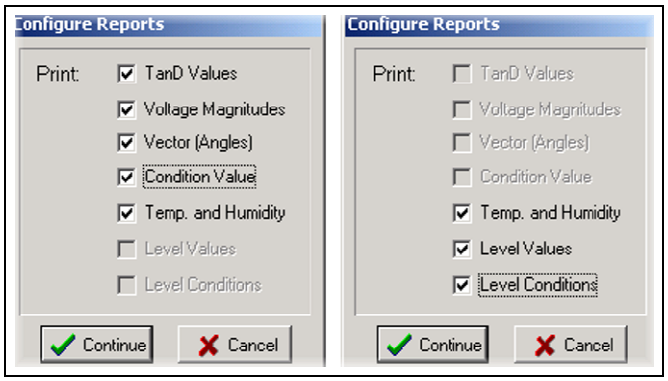
This report consists of condition values vs. time graphs of all units in the system.

Composite Report

Menu *Print Report – Composite Report*

This report consists of various graphs per selected unit. The available graphs on the report depend on the type (level or

non-level) of the selected unit. The user will be presented with the options – select the graphs to include on the report and click *Continue*.



Configure Composite Report

NOTE: *The composite report is only available if a unit has been selected on the main screen.*

Troubleshooting

SOS Monitoring uses some checks to prevent the system from failing to monitor for an extensive period in time:

- An internal watchdog timer in the software will force the PC to reboot ('soft' reboot) if it was determined that the software monitoring cycle was disrupted for more than an hour. For example, if the computer is used for non-SOS functions, such as applications other than *SOS Control* or *SOS Monitoring* programs, a message will appear to give the user a chance to cancel the reboot process before the reboot, in case the user deliberately cancels / pauses the monitoring process. The user may activate the *SOS Control* program at any time to have the watchdog timer reset.
- SOS Monitoring will check the A/D card and driver and will force the PC to reboot ('soft' reboot) if consecutive errors occurred with the sampling process (i.e. could not access the A/D card through the driver). This will pick up problems with the A/D card or A/D card driver and DMA memory access and will reset these problems by rebooting the PC.
- A watchdog board in the InsuLogix® B cabinet is reset every couple of minutes by the Monitoring or Control programs. In case this watchdog board is not reset for a period longer than 15 minutes, the watchdog board hardware will cut the power to the PC in order to force the PC to reboot ('hard' reboot). This will of course only be effective provided the PC is connected to the power out connector on the InsuLogix® B cabinet.

InsuLogix® B Monitoring also keeps log files that can be reviewed for more information on the monitoring process:

'comms.log'	All communication events, including any errors while sending a fax or e-mail.
'adcard.log'	Any errors that occurred with the A/D card are logged in this file.
'reboot.log'	A log file with an entry and reason for every time that the PC104 is rebooted.
alarmlog.txt'	Every time that a user disables or resets an alarm manually, the action is logged in this file.
'condition.txt'	A date/time stamped text file with the latest condition values and signal integrity information, for all units.
'alarmstatus.txt'	A date/time stamped text file with a record of the status of the different system alarms.
'referencewindow.txt'	A text file with a record of the reference window for every unit in the monitoring set (this file indicates the number of records for every unit)
'olddata.txt'	A date/time stamped text file with information about the status of the current database and old database. This file gets updated every time SOS Monitoring executes the archive process.

Database Structure

The InsuLogix® B software uses a standard SQL database server for data storage. By default, InterBase is used as the database server, but the data structure allows for other database servers also to be used.

The client/server model employed by the InsuLogix® B software ensures data integrity and easy remote retrieval and manipulation of data.

Database Files

Data is stored in various database files in the …SOS\Data\ folder. These database files include:

Pescandb.gdb:	Contains the system configuration data.
Pescdata.gdb:	The current monitoring data is stored in the file (all sampled and calculated values).
Pescold.gdb:	This serves as a backup database file for the pescdata.gdb file. This database gets updated with data from the current database once a day and is stored until a new archive database file is created.

Archive database files are created periodically by the system and are stored in the …SOS\Backup\ folder. These files are named SOSyyyymmdd.gdb (where the date is an indication of the date of the most recent data contained in the file) and is a copy of the backup database file (pescold.gdb) for that time interval.

During the installation process, the BDE (Borland Database Engine) aliases for the database files are automatically created. These are pescan for pescandb.gdb, pescdata for pescdata.gdb, and pescold for pescold.gdb.

Database Table Structure

The following table structures are given for reference purpose only. The user is allowed to do simple data retrieval on the database through standard SQL queries, but **is under no circumstances allowed** to manually update or delete data.

Pescandb.gdb

- ALARMS Contains the alarm configuration per unit in the monitoring set.
- PESCMAST Contains all information regarding the physical units (all possible units in the substation) entered into the system (type, manufacturer, etc).
- PESCCONF Contains all utilization information on the units to be monitored (phase, feeder, etc.).
- TEXT Contains the text to be displayed on the layout.
- RPTEMAIL Contains all e-mail report recipients.
- RPTFAX Contains all fax report recipients.

Pescdata.gdb

- ENVIRONMENT Contains temperature and humidity data.
- PESCREF Contains the reference window data.
- PESCTAND Contains the PF/TanDelta sampling data.
- PESCVEC Contains the vector sampling data.
- PESCLEV Contains the level sampling data.
- PESCCOND Contains the condition calculation data for all units.
- PESCSIGNAL Contains information on units from which the signals were down for some time.

Pescold.gdb and Archived Database Files

- ENVIRONMENT Contains temperature and humidity data.
- PESCTAND Contains the PF/TanDelta sampling data.
- PESCLEVC Contains the vector sampling data.
- PESCLEV Contains the level sampling data.
- PESCCOND Contains the condition calculation data for all units.

Backup/Archival Considerations

There is over 100 Megabytes of data storage available for the database on a InsuLogix® B system. To estimate how much data can be stored, the following algorithm can be used. A PF/TanDelta unit having a sampling rate that produces an average sample value every hour will require 5000 bytes of data storage per day. Since there can be at most fifteen PF/TanDelta units in a InsuLogix® B system, the following equation gives the total number of days before the 100 MB of data is exhausted.

Total Days = 100000000 bytes/ (5000 bytes/day * 15 units) = 1333 days or 3.65 years

Therefore, exceeding the allotted data storage has a very small possibility of occurring. However, to insure the availability of the data in the event of a hardware failure, it is recommended that the archive database files (file name format SOSyyyymmdd.gdb) be copied from the InsuLogix® B system to the notebook computer at periodic intervals using the pcAnywhere File Transfer function. Once this archive data has been copied to the notebook computer, the files can be deleted in the InsuLogix® B system to make more storage space available. The data files contained on the notebook can then be transferred to a Network Server or CD to secure the data.

Section 5 - CONSOLE OPERATION

Installing pcAnywhere for Remote access

pcAnywhere is a software package that will allow remote operation of InsuLogix® B cabinet that has been connected directly using a RS232 communications port and a cable or via an optional network connection to a notebook computer. A version of pcAnywhere was pre-installed with InsuLogix® B and configured to automatically startup in the host mode with the Windows operating system. However, pcAnywhere must be installed on the notebook computer before it can communicate with InsuLogix® B.

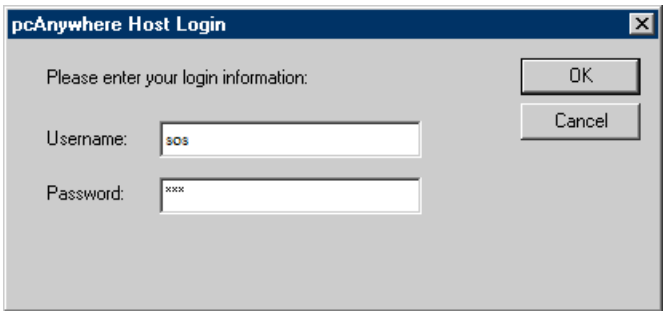
To install pcAnywhere on the notebook computer, place the InsuLogix® B Installation CD in the CDROM of the notebook computer. When the InsuLogix® B startup screen appears, select the InsuLogix® B + Installation item with the cursor and the following display should be displayed.

Move the cursor to the pcANYWHERE line and use the left mouse button to begin the installation process. This will run the setup.exe program in the pcAnywhere folder on the CD. Select the Typical installation and skip over the *Live* Update and Registration operations. When it asks to restart the computer, select the No option and then exit the InsuLogix® B Installation display and select All Done on the InsuLogix® B + screen.

The pcAnywhere installation on the notebook computer needs to be configured for Remote Control. Launch pcAnywhere by selecting the icon or from the programs group (Start – Programs – Symantec pcAnywhere). Select "Remotes" from the toolbar on the pcAnywhere Manager display and double click on *Add Remote* to add an icon for InsuLogix® B. On the Connection Info tab, select the COM port being used or TCP/IP if the optional network connection is being used on the notebook computer. Then enter OK to complete the configuration. Change the "New Remote" name to "InsuLogix® B" and then click the cross in the upper right corner to exit the pcAnywhere Manager display.

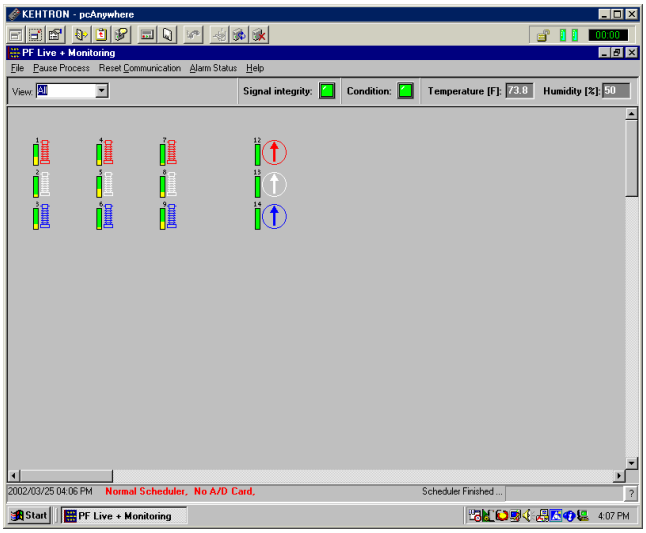
Remote Connection Using pcAnywhere

To use pcAnywhere for direct remote communication with InsuLogix® B, a Null Modem Serial Cable with a DB9 pin male connector on one end and a DB9 pin female connector on the other end is required. The connection is established by double clicking on the pcAnywhere icon on the notebook Windows desktop screen and then double clicking on the InsuLogix® B Remote icon on the pcAnywhere Manager display. The following pcAnywhere Host Login screen is shown and you should enter the Username "sos" and the password "sos" to obtain access to the InsuLogix® B Monitoring display.



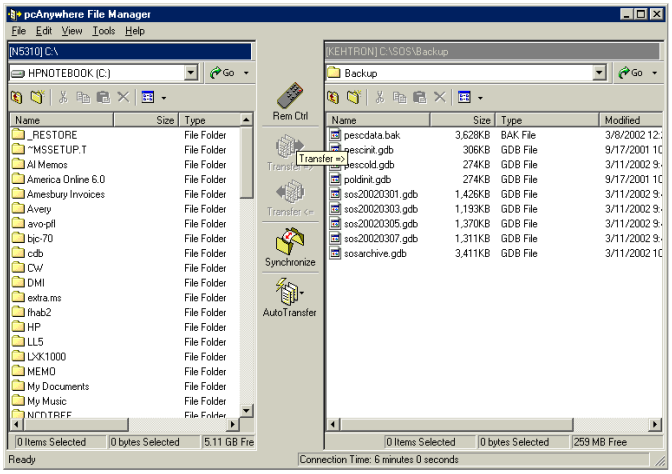
pcAnywhere Host Login Display

Once you have gained access to the InsuLogix® B software, then you can perform the Control, Monitoring, and Graph operations described in Section 4. A sample of the InsuLogix® B Monitoring display is shown below. It is important to realize that the host pcAnywhere menu bar is still active and is shown at the top of the display and it may be necessary to use the right most scroll bar to view the entire InsuLogix® B Monitoring display.



pcAnywhere Display of InsuLogix® B Monitoring

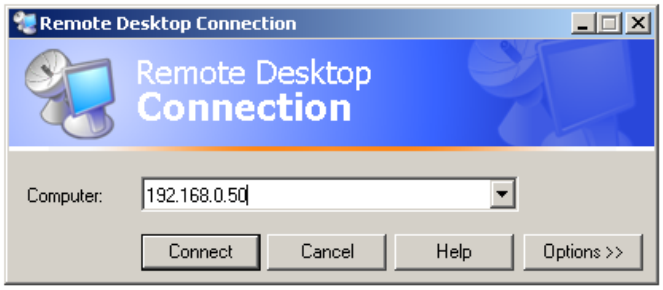
If it is desired to transfer files from the InsuLogix® B system to the notebook computer for backup or archiving purposes, then the File Transfer capability should be utilized by double clicking on the File Transfer icon on the pcAnywhere menu bar at the top of the screen. This will allow you to select the appropriate folder in InsuLogix® B system shown on the right of the screen and the corresponding folder on the notebook computer shown on the left of the pcAnywhere File Manager display as shown in the following figure.



pcAnywhere File Transfer Display

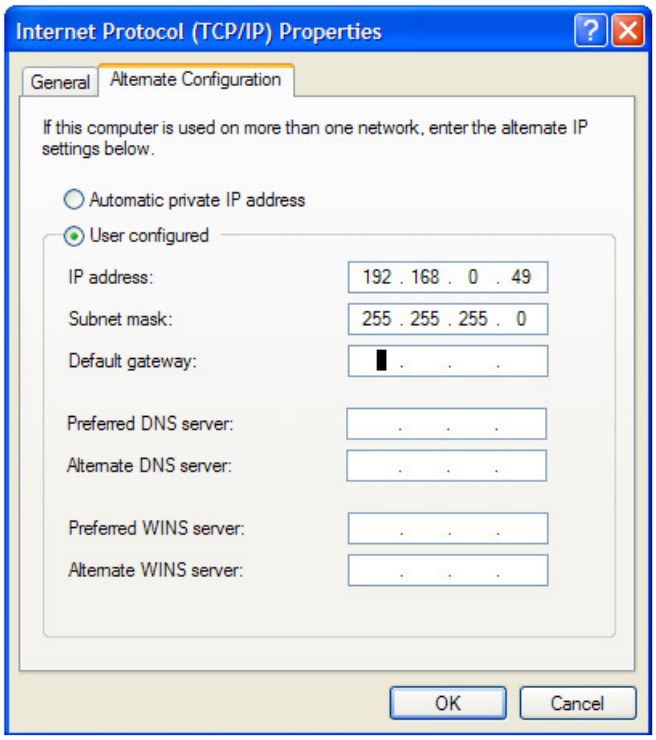
Remote Connection Using Windows® Remote Desktop Connection

To use Windows® Remote Desktop Connection for direct remote connection with InsuLogix® B, a CAT 5 Patch Cable with male RJ45 connectors on both ends is required. The connection is established by clicking on the Remote Desktop Connection icon located in the start menu under **Programs** > **Accessories** > **Communications** > **Remote Desktop Connection** *(Note: Remote Desktop Connection is pre-installed with Windows XP Professional, if you do not have Remote Desktop Connection installed it can be downloaded from Microsoft at: http://www.microsoft.com/windowsxp/downloads/tools/rdclientdl.mspx.)*



Remote Desktop Connection Computer Selection

On the Remote Desktop Connection computer selection screen type in the IP Address of the InsuLogix® B that you would like to connect to. If connecting to the InsuLogix® B from port P2 the IP Address by default is set to 192.168.0.50. When using port P2 the laptop used to connect to the InsuLogix® B must have its own specified IP address. To assign an IP address to the laptop you must go into **Control Panel** > **Network Connections** > **Right Click on Local Area Connection** > **Scroll down to Properties** > **Click on Internet Protocol (TCP/IP)** > **Click Properties** > **Click on the Alternate Configuration tab** > **Type in 192.168.0.48 in the IP address box** > **Type in 255.255.255.0 in the Subnet Mask box** > **Click OK**.



IP Properties Window

If the InsuLogix® B is on a Local Area Network the IP Address will be assigned automatically. The following Remote Desktop Connection Login screen is shown and you should enter the Username "sos" and the Password "sos" to obtain access to the InsuLogix® B Monitoring display.

Remote Desktop Connection Login Display

Once you have gained access to the InsuLogix® B software, then you can perform the Control, Monitoring, and Graph operations described in Section 4.

Section 6 - COMMUICATIONS OPTIONS

Modem Connection Option

If it is desired to have the InsuLogix® B system send Warning, Detail, or Summary Reports by facsimile, then the modem connection option must be installed. Due to the harsh electrical environment at the transformer, the InsuLogix® B cabinet must be connected to an external modem in the Control House using 1300 Nanometer Multimode Fiberoptic cable with ST connectors.

This option requires installing a Async Fiberoptic Mini Modem (e.g. Black Box product ME605A-FST) in the InsuLogix® B cabinet via a short cable with a DB9 pin female connector to the COM 1 port from the PC104 board and the DB25 male connector on the cable to the DB25 female connector on the Async Fiberoptic Mini Modem. The two ST connectors on the fiber optic cables are fed into the bottom of the cabinet and attached to the modem.

The other ends of the fiber optic cables are attached to the ST connectors of the second Async Fiberoptic Mini Modem and the DB25 pin connector is connected to an external modem attached to a phone line in the Control House.

Network Connection Option

If it is desired to have the InsuLogix® B system accessible on a network, then the network connection option must be installed. Due to the harsh electrical environment at the transformer, the InsuLogix® B cabinet must be connected to the Network Hub in the Control House using 1300 Nanometer Multimode Fiberoptic cable with ST connectors.

This option requires installing a Fast Ethernet Media Converter in the InsuLogix® B cabinet with a short CAT 5 Patch Cable with male RJ45 connectors on both ends. The cable is used to connect the Converter to the Network connector on the PC104 Processor Board. External power must be supplied to the Converter and the two ST connectors on the fiber optic cables are fed into the bottom of the cabinet and attached to the terminals on the Fast Ethernet Media Converter.

The other ends of the fiber optic cables are attached to the ST connectors of a Fiberoptic Network Hub in the Control House or to a second Fast Ethernet Media Converter and the Converter is then connected to the Network Hub.

UCA Server Option

Introduction

This InsuLogix® B option enables the Monitoring program to utilize the industry standard UCA (Utility Communication Architecture) protocol. Installing the optional UCA Server in InsuLogix® B and having the hardware connected to a network enables a gateway between InsuLogix® B and the SOS Supervisor. In a typical scenario, UCA Server accepts data requests from the SOS Supervisor and sends the appropriate responses back to SOS Supervisor for each data requests. UCA Server also is able to dynamically create "bricks" associated with each domain, as the user add new units to the InsuLogix® B system.

A stand-alone executable file called *sos_ucaserver.exe* has to be installed in the*\sos* directory. InsuLogix® B Monitoring starts UCA Server by calling *sos_ucaserver.exe*, after it completes the first sampling of all units. There are also three other MMS-EASE LITE configuration files that have to be under *\sos* to make UCA Server work. These are *lean.cfg, mbufcalc.cfg, and mms_log.cfg* files.

UCA Server Input

There are two types of input received from SOS Supervisor, namely UCA variable names and UCA variable name list. Whether one type of input is received over the other, is dependent upon how SOS Supervisor sends out the request. UCA Server does not directly handle low-level communication calls between SOS Supervisor and itself. All low-level communication tasks are done via MMS-EASE LITE services, which are abstract and transparent to UCA Server. At a much higher level, UCA Server assumes the responsibility of executing implementation specific tasks such as database transactions, when it receives a request from the SOS Supervisor. Most implementations take place within "read indication" functions.

The MMS Read indication functions are the major inputs to UCA Server, and the values assigned for each named variables within each read indication functions will be sent back to SOS Supervisor, after each data is retrieved successfully from the database and assigned to each name variables.

UCA Server Output

The following table illustrates naming conventions used for some of the named variable types associated with actual field names stored in the Database table, to which both the InsuLogix® B system and UCA Server have access.

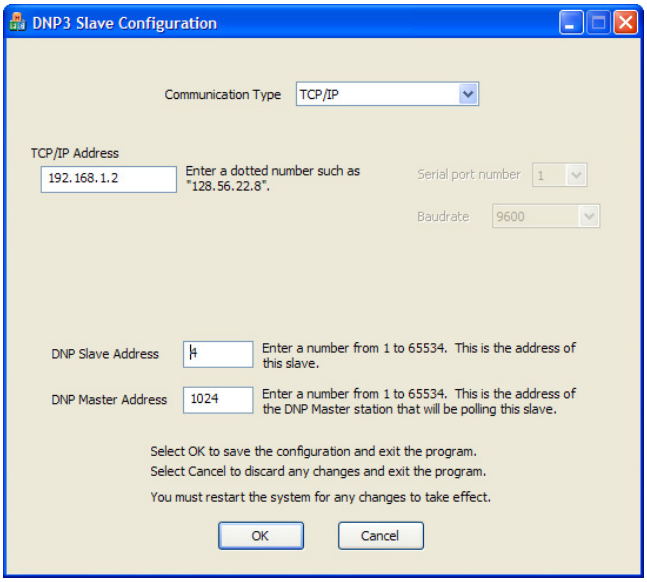
Named Variables	Actual Field Names	SQL Data Type	MMS Data Type	Table
BUSH1MXPF$TanDeltaF	tand	Float	ST_FLOAT	pesctand
BUSH1MXPhsV$Reff	mag1	Float	ST_FLOAT	pesctand
BUSH1MXPhsV$f	mag2	Float	ST_FLOAT	pesctand
BUSH1MXRelCap$f	relcap	Float	ST_FLOAT	pesctand
BUSH1CFUnitId$UnitId	unitid	Smallint	ST_INT16	pesctand
BUSH1CFRefId$RefId	refid	Smallint	ST_INT16	pesctand
BUSH1STCndSt$b2	condition	Smallint	ST_UINT8	pesccond
BUSH1STSigIntg$b16	unitid	Smallint	ST_INT16	pescsignal

DNP3 Option

The DNP Slave program, DNP3Slave, provides data to the DNP Master program. The two programs can communicate via RS232 or Ethernet. The configuration program, DNP3SlaveConfig, provides the means to configure the slave program.

Ethernet Settings

The following screen is displayed for Ethernet configuration.

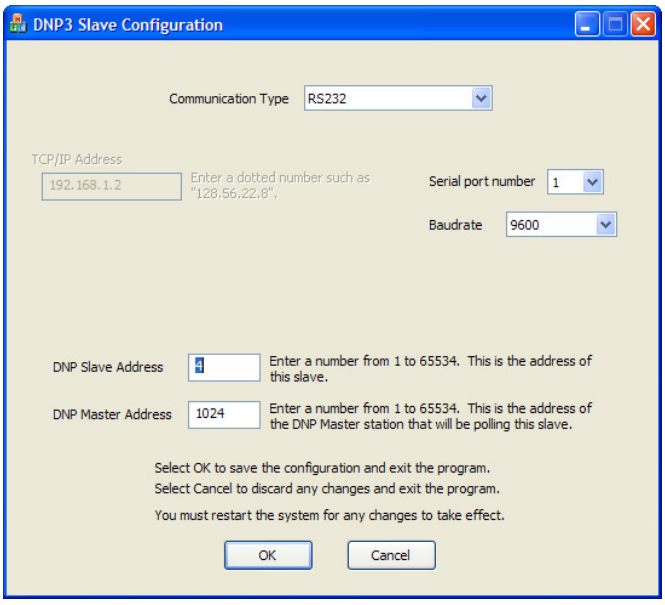

DNP3 Slave Configuration
Communication Type
TCP/IP
TCP/IP Address
192.168.1.2
Enter a dotted number such as "128.56.22.8".
Serial port number
1
Baudrate
9600
DNP Slave Address
4
Enter a number from 1 to 65534. This is the address of this slave.
DNP Master Address
1024
Enter a number from 1 to 65534. This is the address of the DNP Master station that will be polling this slave.
Select OK to save the configuration and exit the program.
Select Cancel to discard any changes and exit the program.
You must restart the system for any changes to take effect.
OK
Cancel

DNP3 Configuration Display for Ethernet Settings

The DNP Master must know the TCP/IP address, the DNP Slave Address and the DNP Master Address.

RS232

The following screen is displayed for RS232 configuration.


DNP3 Slave Configuration
Communication Type
RS232
TCP/IP Address
192.168.1.2
Enter a dotted number such as "128.56.22.8".
Serial port number
1
Baudrate
9600
DNP Slave Address
4
Enter a number from 1 to 65534. This is the address of this slave.
DNP Master Address
1024
Enter a number from 1 to 65534. This is the address of the DNP Master station that will be polling this slave.
Select OK to save the configuration and exit the program.
Select Cancel to discard any changes and exit the program.
You must restart the system for any changes to take effect.
OK
Cancel

Configuration Display for Serial Port settings.

The Master must know the Baudrate, the DNP Slave Address and the DNP Master Address.

Configuration file

The configuration file name is "DNP3SlaveConfig.txt" and it exists in the "C:\sos" directory. The file is maintained by the configuration program.

Configuration file format

- There is one item on a line. The format of the line is
  - ItemName=ItemValue
  - Where:
    ItemName is a text string describing the item.
    ItemValue is the ASCII representation of the value for the item.

- There are no comments.

Items in the Configuration File

- ItemName: Communications
  - ItemValue:
    - 1 = RS232,
    - 5 = Ethernet

- ItemName: SlaveAddr
  - ItemValue:
    - ItemValue: Any valid DNP address number. See the Configuration Program screen above for a description of a valid DNP address.
- ItemName: MasterAddr
  - ItemValue:
    - ItemValue: Any valid DNP address number. See the Configuration Program screen above for a description of a valid DNP address.
- ItemName: TCPIPAddr
  - ItemValue:
    - Any valid TCPIP address.
- ItemName: SerialPortNum
  - ItemValue:
    - One of the values selected from the dropdown list in the Configuration Program.
- ItemName: Baudrate
  - ItemValue:
    - One of the values selected from the dropdown list in the Configuration Program.
- ItemName: Period
  - ItemValue:
    - The period, in seconds, that the program checks for new data.
    - If the period is 0, the program will start once and then terminate.
- ItemName: TCPIPPort
  - ItemValue:
    - TCP/IP port to use.

Operating the form

- Select "TCP/IP" from the ***Communication Type*** dropdown list.
  - The ***Serial port number*** and ***Baudrate*** fields are disabled.
  - Enter a TCP/IP address in the ***TCP/IP Address*** field. The address is checked to make sure it is valid. See the validation rules below.
- Select "RS232" from the ***Communication Type*** dropdown list.
  - The ***TCP/IP Address*** field is disabled.
  - Select a serial port number from the ***Serial port number*** dropdown list.
  - Select a baudrate from the ***Baudrate*** drowdown list.
- Enter a DNP Slave address in the ***DNP Slave Address*** field.
- Enter a DNP Master address in the ***DNP Master Address*** field.
- Select ***OK*** to save the data to the configuration file if all of the data is valid. If any of the data is not valid, none of the data is saved.
- Select ***Cancel*** to discard the changes.

Items that cannot be changed

- The period does not get displayed and it cannot be changed except by manually editing the configuration file.
- The TCP IP port does not get displayed and it cannot be changed except by manually editing the configuration file.

TCP/IP Validation Rules

- Must have 3 dots (4 address sections).
- Each section must have only digits.
- Each section must have at least 1 digit and no more than 3 digits.
- Each section cannot exceed 255.

DNP Address Validation Rules

These rules apply to both the Slave and Master addresses.

- Must have no more than 5 digits.
- Must have all digits.
- Cannot be greater than or equal to 65535.

Classes

All classes and class methods are well documented in the code.

- The CDNP3SlaveConfigDlg class is the main dialog box class and handles all the fields and buttons in the main dialog box.
- The CConfig class reads and writes the configuration file.

Published Data

All data is published as analog floating point numbers with a time stamp.

The order of the data described is the order it is published in (i.e. the DNP point number).

All bushings are published first ordered by unit ID number.

After the bushings, all Level devices are published ordered by unit ID number.

Temperature, always point number 0

Humidity, always point number 1.

Bushings

Point numbers start at 2 for the first bushing. They are numbered consecutively in the order listed below.

For each bushing

- Unit ID

- Phase
  - Phase A = 1
  - Phase B = 2
  - Phase C = 3
- Vector Group
- In Service
  - 1 = In service
  - 0 = Out of service
- Reference ID
- TanDelta
- Mag1
- Mag 2
- PF
- RelCap
- Condition
  - 0 = very good to 110 = bad
- RefTanDelta
- Ref RelCap
- RefPF
- Unit Status
  - Alarm = 0x80
  - Warning = 0x40
  - OK = 0xC0
  - Unknown = 0
- Signal Status
  - Down = 0x40
  - Good = 0x80
- Alarm
  - Off = 0
  - On = 1

Level devices

Point numbers continue from the last point number for the last bushing. They are numbered consecutively in the order listed below.

For each level device

- Unit ID
- In Service
- Upper Value
- Upper Voltage
- Lower Value
- Lower Voltage
- Alarm Value
- Level
- Alarm
  - Off = 0
  - On = 1

- There are no comments.

Items in the Configuration File

- ItemName: Communications
  - ItemValue:
    - 1 = RS232,
    - 5 = Ethernet
- ItemName: SlaveAddr
  - ItemValue:
    - ItemValue: Any valid DNP address number. See the Configuration Program screen above for a description of a valid DNP address.
- ItemName: MasterAddr
  - ItemValue:
    - ItemValue: Any valid DNP address number. See the Configuration Program screen above for a description of a valid DNP address.
- ItemName: TCPIPAddr
  - ItemValue:
    - Any valid TCPIP address.
- ItemName: SerialPortNum
  - ItemValue:
    - One of the values selected from the dropdown list in the Configuration Program.
- ItemName: Baudrate
  - ItemValue:
    - One of the values selected from the dropdown list in the Configuration Program.
- ItemName: Period
  - ItemValue:
    - The period, in seconds, that the program checks for new data.
    - If the period is 0, the program will start once and then terminate.
- ItemName: TCPIPPort
  - ItemValue:
    - TCP/IP port to use.

DNP3 Points List

PointIndex	ObjectNumber	ObjectDataType	Variation	DnpType	Description
0	30	Float	5	AnalogInput	Temperature
1	30	Float	5	AnalogInput	Humidity
2	30	Float	5	AnalogInput	Bushing 1 Unit ID
3	30	Float	5	AnalogInput	Bushing 1 Phase
4	30	Float	5	AnalogInput	Bushing 1 Vector Group
5	30	Float	5	AnalogInput	Bushing 1 In Service
6	30	Float	5	AnalogInput	Bushing 1 Reference ID
7	30	Float	5	AnalogInput	Bushing 1 TanD
8	30	Float	5	AnalogInput	Bushing 1 Mag1
9	30	Float	5	AnalogInput	Bushing 1 Mag 2
10	30	Float	5	AnalogInput	Bushing 1 PF
11	30	Float	5	AnalogInput	Bushing 1 RelCap
12	30	Float	5	AnalogInput	Bushing 1 Condition
13	30	Float	5	AnalogInput	Bushing 1 RefTanD
14	30	Float	5	AnalogInput	Bushing 1 Ref RelCap
15	30	Float	5	AnalogInput	Bushing 1 RefPF
16	30	Float	5	AnalogInput	Bushing 1 Unit Status
17	30	Float	5	AnalogInput	Bushing 1 Signal Status
18	30	Float	5	AnalogInput	Bushing 1 Alarm
19	30	Float	5	AnalogInput	Bushing 2 Unit ID
20	30	Float	5	AnalogInput	Bushing 2 Phase
21	30	Float	5	AnalogInput	Bushing 2 Vector Group
22	30	Float	5	AnalogInput	Bushing 2 In Service
23	30	Float	5	AnalogInput	Bushing 2 Reference ID
24	30	Float	5	AnalogInput	Bushing 2 TanD
25	30	Float	5	AnalogInput	Bushing 2 Mag1
26	30	Float	5	AnalogInput	Bushing 2 Mag 2
27	30	Float	5	AnalogInput	Bushing 2 PF
28	30	Float	5	AnalogInput	Bushing 2 RelCap
29	30	Float	5	AnalogInput	Bushing 2 Condition
30	30	Float	5	AnalogInput	Bushing 2 RefTanD
31	30	Float	5	AnalogInput	Bushing 2 Ref RelCap
32	30	Float	5	AnalogInput	Bushing 2 RefPF
33	30	Float	5	AnalogInput	Bushing 2 Unit Status
34	30	Float	5	AnalogInput	Bushing 2 Signal Status
35	30	Float	5	AnalogInput	Bushing 2 Alarm
36	30	Float	5	AnalogInput	Bushing 3 Unit ID
37	30	Float	5	AnalogInput	Bushing 3 Phase
38	30	Float	5	AnalogInput	Bushing 3 Vector Group
39	30	Float	5	AnalogInput	Bushing 3 In Service
40	30	Float	5	AnalogInput	Bushing 3 Reference ID
41	30	Float	5	AnalogInput	Bushing 3 TanD
42	30	Float	5	AnalogInput	Bushing 3 Mag1
43	30	Float	5	AnalogInput	Bushing 3 Mag 2
44	30	Float	5	AnalogInput	Bushing 3 PF
45	30	Float	5	AnalogInput	Bushing 3 RelCap
46	30	Float	5	AnalogInput	Bushing 3 Condition
47	30	Float	5	AnalogInput	Bushing 3 RefTanD
48	30	Float	5	AnalogInput	Bushing 3 Ref RelCap
49	30	Float	5	AnalogInput	Bushing 3 RefPF
50	30	Float	5	AnalogInput	Bushing 3 Unit Status
51	30	Float	5	AnalogInput	Bushing 3 Signal Status
52	30	Float	5	AnalogInput	Bushing 3 Alarm
53	30	Float	5	AnalogInput	Aux 1 Unit ID
54	30	Float	5	AnalogInput	Aux 1 In Service
55	30	Float	5	AnalogInput	Aux 1 Upper Value
56	30	Float	5	AnalogInput	Aux 1 Upper Voltage
57	30	Float	5	AnalogInput	Aux 1 Lower Value
58	30	Float	5	AnalogInput	Aux 1 Lower Voltage
59	30	Float	5	AnalogInput	Aux 1 Alarm Value
60	30	Float	5	AnalogInput	Aux 1 Level
61	30	Float	5	AnalogInput	Aux 1 Alarm

SECTION 7 - MAINTENANCE

Periodic Testing

⚠ WARNING

THERE IS ALWAYS THE POSSIBILITY OF VOLTAGES BEING INDUCED AT THE TERMINALS OF A TEST SPECIMEN BECAUSE OF PROXIMITY TO ENERGIZED HIGH-VOLTAGE LINES OR EQUIPMENT. A RESIDUAL STATIC VOLTAGE CHARGE MAY ALSO BE PRESENT AT THESE TERMINALS. GROUND EACH TERMINAL TO BE TESTED WITH A SAFETY GROUND STICK, AND THEN INSTALL SAFETY GROUND JUMPERS, BEFORE MAKING OR CHECKING CONNECTIONS. ENSURE THAT THE OBJECT TO BE TESTED IS COMPLETELY DE-ENERGIZED AND DISCHARGED.

It is important that the system is periodically tested, according to prescribed test protocols, to ensure proper operation. InsuLogix® B Control diagnostic utilities can be used to verify signal integrity, as well as to troubleshoot a signal that is down.

To troubleshoot a signal that is down, proceed with these steps:

- Select the Scope Function from InsuLogix® B Control Diagnostics. Enter the channel number of each channel that is down (two channels can be compared for phase relationship and signal integrity).
- If a signal is deformed or missing, begin tracing the signal from the BTC to the InsuLogix® B cabinet. Measure the input channel voltage and compare the amplitude to the other two phases. The amplitudes should be within 15 percent of each other.
- If not within 15 percent, check wire connections at the InsuLogix® B cabinet and follow the wiring to the BTC. Verify that the screen is properly connected for each wire. Ensure that the wire is not nicked or frayed. Examine the BTC to make sure it is sealed properly. Check the terminals for tightness and verify that the shield is properly connected between each wire in the BTC.
- Before checking the InsuLogix® B cabinet, ensure that the device it is attached to is de-energized. Check the wire connections and seals in the InsuLogix® B cabinet.

Repair

WEIDMANN offers a complete repair service and recommends that its customers take advantage of this service in the event of any equipment malfunction. Equipment returned for repair must be shipped prepaid and insured and marked for the attention of the Repair Department. Please indicate all pertinent information, including problem symptoms and attempted repairs. The serial number and catalog number of the system should also be specified. Our shipping address is:

WEIDMANN DIAGNOSTIC SOLUTIONS INC., 230 Gordon Mills Way, PO Box 799, St. Johnsbury, VT 05819-0799, USA T +802 748 8106, F +802 751 3555.

Appendix A - Installation Checklist

Complete one worksheet for each set of three units monitored so a WEIDMANN engineer can use this data to determine the CDU (uF) value and the correct InsuLogix® B Cabinet can be ordered.

Feeder / Bay ID : **Voltage : _____ kV** **Unit :** Bushing / CT		**Capacitance [PF]**	**Measurement Tap - Point present ? [Yes / No] and action**	
Red **Phase A**	**Type** : _____ **Manuf.** : _____ **Ser.No** : _____	C_1 = _____	**Yes** [ ]	Obtain drawings of tap point or of coupling unit.
			No [ ]	For CT decide on isolation method.
White **Phase B**	**Type** : _____ **Manuf.** : _____ **Ser.No** : _____	C_1 = _____	**Yes** [ ]	Obtain drawings of tap point or of coupling unit.
			No [ ]	For CT decide on isolation method.
Blue **Phase C**	**Type** : _____ **Manuf.** : _____ **Ser.No** : _____	C_1 = _____	**Yes** [ ]	Obtain drawings of tap point or of coupling unit.
			No [ ]	For CT decide on isolation method.

ONE-LINE DIAGRAM

To assist in the planning, cable layout and system configuration.

BUSHING TAP COUPLER

For test objects with capacitive tap-point a BTC is required. This unit will be coupled mechanically and electrically to the tap-point via an appropriate adapter bolted or threaded onto the CT or bushing.

Appendix B - Software License Agreement

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GENERAL

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Appendix C - Substation Visual Inspection Procedure

Equipment Required

Notebook Computer with pcAnywhere software installed and the DIRECT Remote configured for the available COM Port. An RS232 Null Modem Serial Cable with a 9 pin male connector on one end and a 9 pin female connector on the other end. The notebook computer battery should be fully charged.

Process Steps

1 Unlock the InsuLogix® B Cabinet, and open the door so that the male connector of the RS232 Null Modem connector can be attached to the cabinet. Attach the other end of the cable to the notebook computer serial port.

2 Turn the computer ON and activate pcAnywhere by placing the cursor on the icon and double click the left mouse button. Left click the Remotes button on the pcAnywhere Manager display and double click on the DIRECT remote that should have already been assigned to use the COM port on the notebook computer.

3 On the pcAnywhere Host Login display, enter the username "InsuLogix® B" and the password "plus" and then depress the Enter key. Activate the InsuLogix® B + Monitoring display, if it is not already being displayed.

4 Record the reference number of any PF/TanDelta unit that has a red or blue cross thru the device symbol or a white cross thru a red device symbol.

5 Record the reference number of any Level unit that has a red horizontal arrow or a red or blue cross in the circle.

6 Record the reference number of any unit that has yellow or red in the top portion of the condition bar.

7 Click the cursor on the Alarm Status item in the menu bar at the top of the InsuLogix® B + Monitoring display to show the Alarm Status display. Record if Alarm 5 is red. Click on the ☒ in the upper right corner of the Alarm Status display to exit this display.

8 Click on the ☒ in the upper right corner of the pcAnywhere display, which is the top most display. This will display a confirmation window to determine if you want to "End Remote Session?". Click on the "Yes" button to return to the pcAnywhere Manager display. Click on the ☒ in the upper right corner to exit pcAnywhere.

9 Shutdown the notebook computer and remove the RS232 cable and lock the InsuLogix® B Cabinet. If any abnormal conditions were recorded, notify the Substation Maintenance Supervisor so that corrective action can be taken using the information contained in the InsuLogix® B Instruction Manual.

Warranty

Products supplied by WEIDMANN are warranted against defects in material and workmanship for a period of one year following shipment. Our liability is specifically limited to replacing or repairing, at our option, defective equipment. Equipment returned to the factory for repair must be shipped prepaid and insured. This warranty does not include batteries, lamps, or other expendable items, where the original manufacturer's warranty shall apply. We make no other warranty. The warranty is void in the event of abuse (failure to follow recommended operating procedures) or failure by the customer to perform specific maintenance as indicated in this manual.